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ABSTRACTS OF CHEMICAL PAPERS PUBLISHED IN BRITISH AND FOREIGN JOURNALS.

PART II.

General and Physical Chemistry.

The Molecular Refraction Coefficient, its Additivity Character and its Use for Determining Constitution. II. The Calculation of Refractive Indices of Aromatic Hydrocarbons. FRITZ EISENLOHR (*Ber.*, 1920, **53**, [*B*], 2053—2063).—In a previous paper (A., 1920, ii, 717) it was pointed out that the "molecular coefficient of refraction," $M \times n_D^{20}$, is more sensitive to constitutive changes in the molecule than the generally employed "molecular refraction." A study of the aromatic hydrocarbons of the benzene series shows that the value of the coefficient depends on the relative positions of the substituting alkyl groups in the ring. The observed values exceed those calculated from the atomic values of the constituent atoms, after allowance has been made for ring formation, by an amount which is termed the *E* value. When the *E* values associated with a limited number of groupings are known, for example, two methyl groups in ortho-, meta-, or para-positions, three methyl groups in 1:2:4-positions, etc., it becomes possible to calculate the *E* value, and consequently the molecular coefficient of refraction and refractive index, of any hydrocarbon of the series. A number of typical examples of such calculations are given. E. H. R.

The Dispersion of the Refraction of Hydrocarbons. E. DARMOIS (*Compt. rend.*, 1920, **171**, 952—955).—The specific dispersion of a substance is defined as being the ratio $\Delta n/d$, where

Δn is the difference in the refractive indices for H_α and H_γ, and d is the density at the same temperature. The value of this ratio is apparently constant within one or two units for each type of hydrocarbon, and thus serves to distinguish between saturated, unsaturated, and benzenoid hydrocarbons. The value of $\Delta n/d$ in the case of unsaturated hydrocarbons increases with the number of ethenoid linkings in the molecule. W. G.

Effect of Concentration on the Spectra of Luminous Gases. T. R. MERTON (*Proc. Roy. Soc.*, 1920, [*A*], **98**, 255—260). —There are many cases in which the relative intensities of the lines in a mixture of two gases are altered by the inclusion of a condenser and spark-gap in the electrical circuit. The phenomena have been attributed to changes in the electrical conditions, but experiments described indicate that the ultimate cause may be an alteration of the relative proportions of the two gases in the capillary of the discharge tube.

The broadening and enhancement of certain lines in the case of sodium and lithium when one element is added to the other have been referred to temporary association of atoms of the two elements, but experiments with these elements seem to exclude this explanation. J. R. P.

Excitation of the Spectrum of Helium. K. T. COMPTON and E. G. LILLY (*Astrophys. J.*, 1920, **52**, 1—7).—A discussion of the minimal voltage required for the excitation of the different components of the helium spectrum. Radiation is excited by a stream of electrons emitted by an incandescent tungsten wire, and drawn through the gas to a nickel disk anode by a field which can be varied between 0 and 120 volts. Observing proper precautions, it was possible to obtain a brilliant helium spectrum free from all impurities, including hydrogen, neon, and the vapours of mercury and water. The band spectrum, very intense under these conditions, is thus conclusively shown to belong to helium. The band spectrum and the singlet and doublet series appear simultaneously at 25·5 volts with low pressures and at voltages as low as 20 with higher pressures and current densities, pressures up to 24 mm. being used. The corresponding voltages for the enhanced line at λ 4686 Å. are 80 and 55 volts. These results indicate that the minimal voltages for the excitation of the normal helium atom by a single electronic impact are 25·5 and 80 volts, but when multiple impacts assist, the corresponding voltages may drop to 20 and 55, but no lower. The last value agrees with that predicted by the Bohr theory for the energy necessary to displace the second electron from a singly ionised helium atom. The fact that after striking the arc it can be maintained on as little as 8 volts by using high currents indicates that in an intense discharge a large proportion of the atoms is in an abnormal state, and therefore requires less energy for excitation. The relative intensities of the different components of the spectrum change with varying conditions. As the voltage is increased, the sharp, subordinate

series becomes relatively weaker. As the pressure is increased, the band spectrum becomes stronger and the enhanced line weaker. The former is stronger near the cathode, the latter near the anode. The addition of a trace of neon caused the neon lines λλ 5331 Å. and 5431 Å. to appear with remarkable intensity.

Chemical Abstracts.

A Band Spectrum from Mercury Vapour. C. D. Child (*Science*, 1920, **52**, 248—249).—A continuous spectrum is produced by mercury vapour which is condensing by means of a low-voltage discharge obtained from a transformer of a Wimshurst machine. The spectrum is independent of the purity of the mercury or of the material of the electrode or glass. The glow lasts about 0·001 second, and the radiators do not bear charges.

Chemical Abstracts.

Spark Spectra of Mercury, Copper, Zinc, and Thallium in the Extreme Ultra-violet. Léon Bloch and Eugène Bloch (*Compt. rend.*, 1920, **171**, 909—912).—The spark spectrum of mercury between λ 1650 and 1400 is given, and thirty-six new lines are reported. The spectrum for copper is given between $\lambda=1790$ and 1543, and seventeen new lines are recorded. The spectrum of copper is terminated by a characteristic group of four lines at $\lambda=1552\cdot3$, 1550·2, 1548·0, and 1543·0. The spark spectrum of zinc between $\lambda=1850$ and 1445 shows twelve new lines. The spark spectrum of thallium between $\lambda=1840$ and 1477 is given, and contains thirteen new lines. W. G.

Extension of the Ultra-violet Spectrum. R. A. Millikan (*Astrophys. J.*, 1920, **52**, 47—64).—The extreme ultra-violet spectrum has been extended to λ 202 Å. The source was a high-potential spark, discharged in high vacuum. The vacuum was maintained at less than 10^{-4} mm. by means of a mercury diffusion pump, operated continuously. The current was furnished by the discharge of Leyden jars at a potential of several thousand volts. In such high vacua it was necessary to keep the electrodes at a distance of 0·2 mm. or less, in order to spark between metals, though carbon electrodes could be separated by 1 or 2 mm. The spectra were photographed by means of a concave grating of 83 cm. focal length. The grating was ruled with the exacting requirements of this investigation in view. The spectra of carbon, zinc, iron, silver, and nickel have been extended to λλ 360·5, 317·3, 271·6, 260, and 202, respectively. Excellent illustrations of the extreme ultra-violet vacuum spark spectra of carbon, zinc, iron, and nickel are shown. Evidence is presented for believing that the whole spectrum which the carbon atom is able to emit, up to and including its *X*-radiations of the so-called *L*-series, has now been obtained. Various formulæ for predicting the position of this series are discussed. Previously, no lines of the *L*-series of any element with an atomic number less than 30 had been identified. The conclusion is drawn that high-potential vacuum sparks are

sources of X-rays; in fact, X-rays were observed in these sparks by the usual means. CHEMICAL ABSTRACTS.

Wave-lengths longer than 5500 Å. in the Arc Spectra of Seven Elements. C. C. KIESS and W. F. MEGGERS (*Bur. Standards, Bull.*, 1920, **16**, 51—73; *Sci. Paper* **272**).—The concave grating spectrograph of the Bureau of Standards was used in photographing the yellow, red, and infra-red arc spectra of titanium, vanadium, chromium, manganese, molybdenum, tungsten, and uranium. The photographs were made on plates sensitised to the red and infra-red rays with pinacyanol and dicyanin. The wave-lengths of about 200 lines in the arc spectrum of titanium were measured between the limits 5500 Å. and 9743 Å., 250 lines to 9522 Å. in vanadium, 130 lines to 9734 Å. in chromium, 193 lines to 9576 Å. in manganese, 545 lines to 9721 Å. in molybdenum, 478 lines to 9159 Å. in tungsten, and 680 lines to 9530 Å. in uranium. Many of the measurements represent wave-lengths of heads of bands which are especially prominent in the spectra of titanium, vanadium, and chromium. Impurity lines were eliminated from the tables so far as known, those not identified being brought together in a separate table. Lines the wave-lengths of which agree with those in the series spectrum of oxygen were repeatedly observed in the spectra of arcs in air. Frequency differences which are suspected of being constant were found in each of the spectra. CHEMICAL ABSTRACTS.

Elements in the Sun. (Paper B.) MEGH NAD SAHA (*Phil. Mag.*, 1920, [vi], **40**, 808—824).—No evidence of the existence of the following elements in the sun has been obtained: rubidium, cæsium, nitrogen, phosphorus, boron, antimony, bismuth, arsenic, sulphur, selenium, thallium, praseodymium. Doubtful indications of the following have been obtained: radium, elements of the inert group, except helium, osmium, iridium, platinum, ruthenium, tantalum, thorium, tungsten, uranium. The following are represented by faint lines in the Fraunhofer spectrum: potassium, copper, silver, cadmium, zinc, tin, lead, and germanium. Chlorine, bromine, iodine, fluorine, and tellurium have not been investigated.

It is usually assumed that elements of which no indications are found in the Fraunhofer or flash spectra are totally absent from the sun. The view is urged, however, that the varying records of different elements in the Fraunhofer spectrum may be regarded as arising from the varying response of these elements to the stimulus arising in the sun. This stimulus is the same for all elements, namely, a temperature of 7500° abs., but, owing to differences in internal structure, elements will respond in different degrees to this stimulus. This theory is examined from the point of view of the ionisation potentials of the various elements. J. R. P.

Absorption of some Diatomic Gases in the near Infra-red. ELMER S. IMES (*Astrophys. J.*, 1919, **50**, 251—276).—The importance of the study of absorption bands of gases in the near

infra-red arises, first, from the information given with regard to the structure and mechanics of the molecule, including inferences as to atomic structure, and, secondly, in the new application and test of the quantum theory extended to the rotational energy of molecules. A summary of the theory and previous work is given. More extended and more accurate data are obtained of the absorption bands of hydrogen fluoride, chloride, and bromide Tables and curves are presented showing the bands of hydrogen chloride at 1·76 μ and 3·46 μ in great detail, and giving for hydrogen bromide a similar band at 3·9 μ resolved into its quantum lines, and, for hydrogen fluoride, a band at 2·5 μ, which has not been studied before. The positions of the absorption maxima are determined with an accuracy of several Ångström units. From experimental results, the lengths and moments of inertia of these three molecules are computed: $l \times 10^8 = 0·94$, 1·28, and 1·42, and $I \times 10^{40} = 1·37$, 2·64, and 3·27 for hydrogen fluoride, chloride, and bromide respectively. Instead of perfect symmetry of maxima, that is, arithmetical progression in the frequencies of the maxima, there is a gradual increase in the frequency difference between two adjacent maxima in the infra-red in the direction of longer wave-length, indicating that the vibration frequency of the atoms in the molecule is dependent on the rotation frequency of the molecule. Kemble (A., 1917, ii, 402) advanced the theory that if the amplitude of vibration of the molecule is that required by even a single quantum, the infra-red absorption bands should be accompanied by faint harmonics. Doublets agreeing approximately with the predictions were previously found, and inexact verification was explained by errors in dispersion curves. Only one harmonic, in the case of hydrogen chloride, was observed in this work, the ratio being 1·963 : 1 instead of the expected 2 : 1, that is, the harmonic is 0·033 μ further in the infra-red than the predicted position.

CHEMICAL ABSTRACTS.

Spectro-chemical Study of the Allyl- and Methylalyll*cyclo*-hexan-2-ones. R. CORNUBERT (*Compt. rend.*, 1920, **171**, 919—921, 1060—1062).—The values of the refractive indices, n^{24}, and the densities, D_4^{24}, of the α-allyl derivatives of *cyclo*hexanone, and of α-, β-, and γ-methyl*cyclo*hexanones, are given. For each series of ketones there is an alternation in the variation of the density with respect to the number of alkyl groups in the α-position. In every case, the ketone with three alkyl groups only shows a slight increase in its refractive index over that of the next lower member. The formation of a "double" group of the type CRR: causes a depression of the molecular refraction, whilst the formation of a "single" group of the type CHR: is without appreciable influence on its value.

Starting with 1 : 1 : 3 : 3-tetramethyl*cyclo*hexan-2-one, and replacing the methyl groups one at a time by an allyl group, the effect on the molecular refraction has been observed. The results show the absence of any influence due to dimethyl groups, but the

marked effect due to diallyl groups. The data given support Auwers' theory on the influence of double groups on the value of the molecular refraction. W. G.

Colour and Chemical Constitution. X. A General Numerical Solution of the Colour-Constitution Problem. JAMES MOIR (*Trans. Roy. Soc. S. Africa*, 1920, **8**, 303—311. Compare A., 1920, ii, 573).—It is suggested that the influence of various substituents on the wave-lengths of absorption bands of dyes of the triphenylmethane series is represented by definite factors, which are derived as follows. That for *p*-OH, for example, is obtained from the ratio $\lambda_{\text{aurin}}/\lambda_{\text{benzaurine}} = 0{\cdot}9657$. Similarly, values (in parenthesis) are derived for *p*-NH_2 (0·972), *N*-methyl (1·0245) [giving NHMe (0·9965) and NMe_2 (1·021)], *N*-ethyl (1·023); for the phthaleins, *o*-CO_2H (1·002), *o*-Me, –Et, $C_3H_7{}^{\beta}$, –Cl –Br, –I (1·013 ± 0·001), γ-OMe (0·973), *o*-OH (1·030), *o*-OMe (1·037), α-SO_3H (1·018). Values of a more tentative character, owing to lack of data for purposes of control, are also given for α-Br (1·027), β-Br (1·022), γ-Br (0·975), β-CO_2H (1·012), γ-CO_2H (0·995), β-SO_3H (1·01), γ-SO_3H (1·027), ε-SO_3H (1·010), α-NH_2 (1·022), *C*-Ph (1·026). The colour factor for four methyl groups appears also to apply to the thiophenazine dyes, since $\lambda_{\text{methylene blue}}/\lambda_{\text{thionine}} = \lambda_{\text{malachite green}}/\lambda_{\text{Doebner's violet}}$. The factor for replacement of –CH: by –N: (triphenylmethane → indamine series) is about 1·20. J. K.

The Light Diffused by Argon. LORD RAYLEIGH (*Compt. rend.*, 1920, **171**, 1002).—In connexion with a recent paper by Cabannes (A., 1920, ii, 722), the author draws attention to his own revised value of 99·1% for the degree of polarisation of the light diffused by argon (compare *ibid.*, ii, 574). W. G.

Dependence of Optical Rotatory Power on Chemical Constitution. III. 1 : 4-Naphthylenebisiminocamphor. BAWA KARTAR SINGH and MAHAN SINGH (T., 1920, **117**, 1599—1601).

Dependence of Electrical Double Refraction on Temperature. NIKOLAUS LYON and FRITZ WOLFRAM (*Ann. Physik*, 1920, [iv], **63**, 739—752).—The dependence of the electrical double refraction of ethyl ether, carbon disulphide, and toluene was determined for various temperatures between 18° and −78·5°, and the results compared with the theories of Langevin and of Born. The agreement with the theory of Langevin was good, but the values calculated by Born's formula were, without exception, higher than the observed results. J. R. P.

The *K* characteristic Absorption Frequencies for the Chemical Elements Magnesium to Chromium. HUGO FRICKE (*Physical Rev.*, 1920, **16**, 202—215).—Photographs showing the discontinuities in the *X*-ray absorption bands correspond-

ing with the K-series of the elements from magnesium to chromium were studied. The wave-lengths of the more important parts are tabulated, and indicate considerable complexity.

CHEMICAL ABSTRACTS.

The Charge on the Atomic Nucleus and the Law of Force. J. CHADWICK (*Phil. Mag.*, 1920, [vi], **40**, 734—746).—The charges on the nuclei of three atoms have been measured by a direct method depending on the scattering of α-particles. The values found were: platinum 77·4, silver 46·3, copper 29·3, in fundamental units of charge. The atomic numbers of these elements are 78, 47, and 29, respectively.

The particles were scattered by causing them to pass through thin metal foil in the form of an annular ring subtending a fairly wide cone at the source. Both the scattered and direct particles were counted on the same zinc sulphide screen under the same conditions. In this way, the counting was more convenient, and a greater number of particles could be counted than with former methods.

The law of force around the platinum nucleus was tested by measuring the dependence of scattering on the velocity of the α-particle. The result showed that the inverse square law holds accurately in the region concerned, namely, about 10^{-11} cm. from the nucleus.

The results obtained, together with those of other experimenters, show that, measured from any point in the region between 3×10^{-12} cm. and 10^{-10} cm. from the nucleus of a heavy atom, like platinum, the charge is equal to the atomic number, and the law of force is the inverse square. It may therefore be concluded that no electrons are present in the region between the nucleus and the K ring.

J. R. P.

Cathode Fall in Neon. ARTHUR H. COMPTON and C. C. VAN VOORHIS (*Physical Rev.*, 1920, **15**, 492—497).—Measurements are made of the potential difference between the cathode and the beginning of the positive column when a discharge is passed through pure neon, using a number of different metals as cathode. The "normal cathode fall," or potential difference, between the cathode and the cathode glow for normal current is also determined for several metals. It is found that for normal current the potential difference between the cathode and the positive column is very nearly proportional to the potential differences between the cathode and the cathode glow when different metals are used as cathode. The values in volts of the normal cathode fall in neon were found to be: with Pt cathode 152, W 125, Tl 125, Al 120, Mo 115, Mg 94, Ca 86, Na 75, and K 68. These values are in the order, as far as available data go, of the contact potential series, and are consistently slightly lower than the corresponding values in helium.

CHEMICAL ABSTRACTS.

The Independent Origin of Actinium. ELLIOT QUINCY ADAMS (*J. Amer. Chem. Soc.*, 1920, **42**, 2205—2208).—Piccard's assumption (A., 1918, ii, 6) that the actinium series is derived neither from uranium-*I* nor from uranium-*II* does not require, as supposed by Soddy (A., 1918, ii, 211), the identity of the periods of the first and third. The relation of the uranium, actinium, and thorium series becomes more symmetrical if a hypothetical isotope of proto-actinium (ekatantalum or uranium-*Z*) is assumed as the parent of actino-uranium by a β-ray transformation. This element and actino-uranium have assigned to them an atomic weight 235, corresponding with proto-actinium 231, actinium 227, and actinium lead 207. The last value agrees well with Hönigschmid's value of 206·05 for the atomic weight of uranium lead containing approximately 3% of actinium lead. J. R. P.

Rate of Decay of Actinium and the Transformation Relationships of the Actinium Series. STEFAN MEYER (*Wien. Anzeiger*, 1920, 133; from *Chem. Zentr.*, 1920, iii, 761). —The half-life period of actinium is calculated to be about sixteen and a-half years, and the transformation ratio of the actinium to the uranium–radium family to be 4%. H. W.

Resonance Potentials and Low-voltage Arcs for Metals of the Second Group of the Periodic Table. F. L. MOHLER, PAUL D. FOOTE, and W. F. MEGGERS (*J. Opt. Soc. Amer.*, 1920, **4**, 364—370).—A four-electrode tube was used, in which a hot wire cathode was surrounded by two cylindrical grids and a plate The grids, of which one is close to the cathode and the other close to the plate, are maintained at the same potential by a metallic contact; a variable accelerating field for electrons is used between the cathode and inner grid, and the current reaching the plate against a small retarding field between the outer grid and plate is measured. The ionisation and resonance potentials, in volts, were found to be: zinc 9·3, 4·18, 5·65; cadmium, 9·0, 3·95, 5·35; mercury, 10·2, 4·76, 6·45; magnesium, 8·0, 2·65, 4·42; calcium, 6·01, 1·90, 2·85. In all cases, the values are compared with the theoretical values. Some general conclusions are drawn for electron impacts with molecules of metals of the second group. J. R. P.

The Nature of the Ions produced by Phosphorus. J. A. MCCLELLAND and P. J. NOLAN (*Proc. Roy. Irish Acad.*, 1919, **35**, [*A*], 1—12).—The work was undertaken to see if any of the groups of ions of various characteristic mobilities, obtained by bubbling air through mercury and through alcohol, were present in the ionisation produced by drawing air over phosphorus. Under various conditions, fourteen different types of ions have been found in this air, with mobilities, in a field of 1 volt/cm., of 0·22, 0·092, 0·053, 0·028, 0·018, 0·0074, 0·0041, 0·0024, 0·0012, 0·00064, 0·00031, 0·00015, 0·000085, and 0·000053 cm./sec. Some of the more mobile ions are only obtained in dried air with a short

interval between formation and measurement, and some of the slower ions only in undried air with a long time interval. Both positive and negative ions in each group are present in similar quantity, and the mobility does not change with time. All the ions produced by phosphorus, except the two slowest, are observed in bubbling experiments, which points to the conclusion that they are largely composed of water. Different nuclei in different cases appear to act as the starting point of the ion, but the growth system seems to be the same in the case of phosphorus ionisation as in the case of bubbling. F. S.

Behaviour of Electrolytic Ions in Solid Substances. II. Dissociation Relationships in Permutite. A. GÜNTHER-SCHULZE (*Zeitsch. Elektrochem.*, 1920, **26**, 472—480. Compare A., 1919, ii, 490).- The electrolytic conductivity and the volume change of permutite mixtures have been determined for the base exchange, potassium–cadmium, potassium–lead, lithium–cadmium, and potassium–chromium. The observed values, and those calculated on the basis of theoretical considerations, are in very good agreement, so that the author is enabled to make the following statements. The dissociation relationships of potassium permutite and lithium permutite are approximately the same, just as are those of similar salts in aqueous solution, and they change in the same way on dilution. The laws governing the influence of two salts with the same anion on the dissociation are true for solid permutite, in exactly the same way as for salts in solution. By the continuous replacement of the cation of a strongly dissociated permutite by that of a weakly dissociated permutite, the mobility of the former is reduced, since the undissociated, and therefore stationary, cation of the second permutite reduces the space available for the movement of the first cation. Permutite takes up a volume, determined by every type of cation in it, since each pure permutite has a different molecular volume, which depends on the ion volumes of the base. The molecular volume changes with base interchange proportionally with the amount of interchange as long as the amount of water of crystallisation remains constant. This will also affect the space available for the migration of the cation. All permutites examined up to the present contain $5H_2O$, except chromium permutite, and this contains $13H_2O$. These enter into the interior of the molecule, which is thereby considerably loosened, so that the mobility of the chromium cation is very much increased, and in the case of pure chromium permutite has a value of the same order as that of the chromium ion in aqueous solution. In those cases where the base interchange brings about a very small electrolytic conductivity, the interchange is very slow, so that as much as ten days is required for complete reaction.

J. F. S.

A New Method for the Estimation of Electrolytic Conductivity of Solutions. JOHANNE CHRISTIANSEN (*Hospitalstidende*, **63**, 297–302; from *Chem. Zentr.*, 1920, iv, 568—569).—A

vessel with the liquid under investigation and a voltmeter are connected in series in a direct current circuit of known potential. If the resistance of the vessel is not negligibly small compared with that of the voltmeter, the latter does not indicate the known potential, but some lower value. A convenient vessel for the examination of urine is formed by a U-tube, the greater part of which is constructed from a capillary tube 32 cm. long and 1·8 mm. in diameter. The apparatus is calibrated with the aid of solutions of known conductivity. The method is useful when rapid estimations are required which need not be performed with extreme accuracy. H. W.

Electrical Conductivity of Gelatin Mixtures and their Behaviour during the Transition of the Gelatin. F. Rettig (*Kolloid Zeitsch.*, 1920, **27**, 165—172).—The electrical conductivity of gelatin–water mixtures of concentrations 2·07% to 25·37% has been determined at 18°. The specific conductivity increases rapidly, and approaches at the higher concentrations to a maximum. Further measurements with gelatin–water mixtures to which additions of potassium chloride, bromide, or sulphate have been made in concentrations varying between $0{\cdot}01N$ and $0{\cdot}5N$. The effect of the change of gelatin into β-gelatin has also been investigated by measuring the conductivity after the mixture has been heated at 80° for specified periods of time. When small quantities of salts are added to the gelatin–water mixture, the conductivity becomes greater than that of an aqueous solution of the added salt of the same concentration, but with a larger addition of electrolyte the results are reversed. If it be assumed that, on the addition of an electrolyte, the conductivity of the mixture is made up of the sum of the conductivities of the components, it follows that the conductivity calculated for the mixture is greater than the measured value, and increasingly greater the larger the amount of salt added. This reduction of the conductivity is attributed to the influence of the pure gelatin on the conductivity. The influence of gelatin on the conductivity of different salts may be expressed by a series similar to the Hofmeister series. On continued heating, the gelatin is gradually converted into β-gelatin. This change in the present case brings about an irreversible increased conductivity. The velocity of the change increases with the duration and temperature of the heating, and is greater in dilute mixtures than in concentrated mixtures. The addition of electrolytes effects the change in different ways, depending on the concentration and the nature of the ions of the electrolyte. J. F. S.

Electromotive Properties of certain Binary Alloys. I. Theoretical Considerations. Robert Kremann (*Zeitsch. Metallkunde*, 1920, **12**, 185—191; from *Chem. Zentr.*, 1920, iii, 684).—A general theoretical account is given of the dependence of the potential of solid metallic alloys on their composition, and

the application of this relationship to the elucidation of their constitution. H. W.

Electromotive Properties of certain Binary Alloys. II. Electromotive Behaviour of Silver-Cadmium Alloys. ROBERT KREMANN and HELMUT RUDERER (*Zeitsch. Metallkunde*, 1920, **12**, 209—214; from *Chem. Zentr.*, 1920, iii, 684. Compare preceding abstract).—A series of cells composed of cadmium, cadmium sulphate, and cadmium silver alloys of varying composition have been examined, the initial potential observed immediately on bringing the electrodes into the solution, and the final potential, generally attained after six to eight hours, being observed. The initial potential sinks rapidly at first, then more slowly, and finally asymptotically approaches its final value. The initial potential of alloys richer in silver is somewhat variable. The less noble values only decrease slowly and fairly uniformly at first from the cadmium potential with increasing silver content (to about 50 millivolts), and only exhibit a marked drop in potential with more than 90 at. % silver; in addition to these less noble values, alloys containing more than 25% of silver exhibit higher initial potentials (as much as 150—170 millivolts greater than that of cadmium). Since this observation is also made with alloys which have been tempered at about 400°, the fluctuations cannot be attributed to failure to ensure equilibrium in their preparation. The initial and final potentials differ but little from one another with alloys containing up to 20 at. % of silver; from 20—40 at. %, the latter fall rapidly to the nobler potentials, and with increasing silver content approach the potential of pure silver asymptotically.

In the authors' opinion, the least noble of the measured initial values is the true potential of the alloy. The compounds present in the series of alloys, and also the mixed crystals up to about 90 at. % of silver are therefore but little more noble than cadmium. Owing to the absence of silver ions, it would be expected, on theoretical grounds, that silver would pass into solution and the potential gradually become less noble. The non-fulfilment of this expectation is explained by the authors on the supposition that local elements are immediately formed in which increasingly noble layers are developed by the solution of the less noble portions, and this hypothesis also accounts for the occurrence of more noble, as well as less noble, initial potentials. The falling away of the final potentials from 20 to 40 at. % of silver is probably to be ascribed to a galvanic resistance limit, such as has been described by Tammann. H. W.

Hydrogen Overvoltage. DUNCAN A. MACINNES (*J. Amer. Chem. Soc.*, 1920, **42**, 2233—2238).—The disagreement between the author and Newbery (A., 1920, ii, 727) depends, among other things, on difference in the use of the term "overvoltage." According to Newbery's implied definition, the expression should be reserved for potentials determined by a commutator device which periodically opens the exciting current at the electrode under

examination and closes the potentiometer circuit connecting this electrode and a reference electrode. In the work of MacInnes and Adler (A., 1919, ii, 131), and of practically every worker in this field, the exciting current remains flowing while the potentiometer measurements are made. Newbery appears to be nearly, if not quite, alone in thus restricting the meaning of the term. The difference between the two kinds of overvoltage is equal to Newbery's "transfer resistance."

The formation of a film of gas over the electrode, which Newbery considers as the source of transfer resistance, does not occur except over a very small part of the electrode used by the author, and the ohmic "transfer" resistance due to such a film is open to serious question.

Newbery's contention that transfer resistance may seriously affect conductivity measurements is not in agreement with the results of Eastman (A., 1920, ii, 578), which show that conductivities determined by direct and by symmetrical alternating-current measurements are equal within 0·02—0·03%, and also agree with Kohlrausch's values, although the latter were not determined with pure sine-wave current.

The "transfer resistance" of Newbery is probably a potential. It appears that all the facts, including those brought to light by Newbery's experiments, can be explained by the theory advanced by MacInnes and Adler. J. R. P.

Determination of the Hydrogen-ion Concentration in Pure Water by a Method for Measuring the Electromotive Force of Concentration Cells of High Internal Resistance. H. T. BEANS and E. T. OAKES (*J. Amer. Chem. Soc.*, 1920, **42**, 2116—2131).—A new method of measuring the *E.M.F.* of concentration cells has been applied with an accuracy of 0·5 millivolt. The method consisted essentially in connecting the given cell with a standard condenser and discharging through a galvanometer. By comparing the deflexion with that given by a standard cell used under the same conditions, the ratio of the *E.M.F.* was found: $E_1/E_2=d_1/d_2$. The hydrion concentration of pure water is found to be $1{\cdot}23\times10^{-8}$, or $10^{-7{\cdot}91}$. The time required by the cell $Hg|HgCl,KCl|KCl|H_2O|H_2$ to charge a condenser of 1 microfarad capacity is three to five minutes. For a cell of low internal resistance, such as $Hg|HgCl,KCl|KCl|HCl|H_2$, only an instant is required to charge the condenser. The cell

$$Hg\,|\,HgCl,KCl\ \text{sat.}\,|\,KCl\ \text{sat.}\,|\,H_2O\,|\,H_2$$

reaches its maximum voltage in from forty minutes to one hour, and then remains constant for at least twenty-four hours.

J. R. P.

Electrolytic Pole-finder for Laboratory Use. ERWIN PINOFF (*Chem. Zeit.*, 1920, **44**, 914—915).—For the detection of defects in electric leads and for the determination of polarity, the carbon filament lamp is replaced by two pieces of apparatus depending on electrolytic effects. In one, two burette clips are

fastened to a piece of glass, on which is laid a strip of paper moistened with water to which phenolphthalein has been added. Leads from the clips are applied to the circuit to be tested, and a red coloration under one clip indicates the cathode. In the other, the solution is contained in a short tube, from the ends of which the leads are taken. J. R. P.

Measurement of Electro-osmotic Tensions in Liquids of Low Conductivity. W. STASZEWSKI (*Krakau Anzeiger*, 1917, [*A*], 269—278; from *Chem. Zentr.*, 1920, iii, 782).—The term electro-osmosis is considered to denote the transport of a fluid along the surface of contact with a solid substance under the influence of an electric current; the converse phenomenon, the development of a current by the movement of two media along the surface of contact, is termed current stream. The movement of a liquid along the walls of the containing vessel when, for example, the fluid is positively charged relatively to the wall, causes a transport of electricity in the direction of the current. Under the influence of the external electric field, the charged liquid layer becomes set in motion, and carries with it the neighbouring particles in consequence of internal friction. If K is the DE, λ the specific conductivity, μ the coefficient of internal friction of the liquid, $(\phi_1-\phi_0)$ the difference of potential of the electrical double layer at the surface of contact of liquid and wall of tube, and P the difference of pressure at the ends of the capillary, the current developed by the flow of liquid in the capillary can be calculated from the formula $E=K(\phi_1-\phi_0)P/4\pi\lambda\mu$. In the present communication, which is devoted to the proof of this theory (as far as the dependence of electro-osmotic tension on external pressure is concerned) and to the estimation of the constants $K(\phi_1-\phi_0)$ of badly conducting substances, the author uses a method which depends on the measurement of the $E.M.F.$ induced by driving a liquid through a capillary. The experiments were performed with nitrobenzene, ethyl ether, and mixtures of ethyl alcohol and toluene, and have shown that a proportionality exists between the electro-osmotic tension, B, and the external pressure, P. Further mixtures of alcohol and toluene show analogous variations with respect to λ and $K(\phi_1-\phi_0)$; both values decrease with the toluene content, slowly in mixtures poor in toluene, but rapidly in those rich in this substance, so that the ratio $K(\phi_1-\phi_0)/\lambda$ remains of the same order of magnitude, whilst λ diminishes in the ratio 1:10,000. There appears, therefore, to be an intimate relationship between the structure of the electrical double layer and the mechanism of electrical conductivity. Further measurements show that a marked increase in the conductivity of a badly conducting liquid raises the potential difference at the surface of contact with the solid substance. H. W.

A New Transport Apparatus. A. STEIGMANN (*Kolloid Zeitsch.*, 1920, **27**, 37—38).—The apparatus in use for the determination of the migration velocity of colloids has the disadvantage

that it may only be used for electrolyte-free, or at best electrolyte-poor, colloids. The Coehn-Galecki apparatus has been modified to overcome this difficulty. The U-tube is closed at the top by an horizontal tube, which connects both arms of the U-tube, and is itself connected to two small, vertical tubes in which the electrodes are placed. A long stop-cock passes through the middle of the cross-tube and into the bend of the U-tube. The stop-cock is bored so that when the horizontal cross-tube is open, the bend is closed by the stop-cock. The current is switched on with the U-tube open, that is, the current must pass through the colloid being measured; this takes place for a minute, during which time the electrolyte decomposition products remain in the electrode vessels. Then the stopper is turned to open the horizontal tube and, at the same time, close the U-tube, and, further, the direction of the current is changed. This flows through the horizontal tube, but cannot pass through the colloid under investigation, and reconverts the electrolyte decomposition products into the original electrolyte. After a minute, the tap and current are again changed, and so on. J. F. S.

Charging and Discharging Organic Dyes. ALBRECHT BETHE (*Kolloid Zeitsch.*, 1920, **27**, 11–17).—The velocity of kataphoresis of a number of acidic and basic dyes in acid and alkaline solutions of various concentrations has been examined with the object of ascertaining whether the charge on dye substance particles plays any part in the penetration of these substances into living cells. It is shown that all the sulpho-acid dyes migrate to the anode over a wide range of P_H values, but with different velocities varying with the P_H value. These substances, Chicago-blue, benzo-brown, and fast yellow, behave, as regards their coloured part, as true ions, since they are unchanged in the direction of their migration, but they differ from true ions, since the migration velocity does not remain constant with varying concentrations of hydrogen ions. Basic dyes also show a dependence on the hydrogen-ion concentration, but in the opposite sense to that of the acidic dyes. In this case, the smallest velocity is found in the neighbourhood of the neutral point, but generally slightly on the alkaline side of it. In the presence of larger quantities of sodium hydroxide, these dye substances partly change their direction; this is not due to the change in the P_H value, but to the formation of a sodium salt. J. F. S.

Determination of the Colloid Charge. RUDOLF KELLER (*Kolloid Zeitsch.*, 1920, **27**, 255—257).—An answer to the criticisms of Bethe (preceding abstract) concerning the results contained in a previous paper of the author (A., 1920, ii, 786). J. F. S.

Protein Reactions. I. A Microscopical Kataphoresis Method. A. VON SZENT-GYÖRGYI (*Biochem. Zeitsch.*, 1920, **110**, 116—118).—A microscopical kataphoresis device for application in colloidal chemistry is described. S. S. Z.

The Thermal Variation of the Coefficient of Magnetisation of some Anhydrous Chlorides and an Oxide in the Solid State, and the Theory of Magneton. PH. THÉODORIDÈS (*Compt. rend.*, 1920, **171**, 948—950).—The substances examined were cobalt, nickel and manganous chlorides, and manganous oxide. For the first two chlorides, the results obtained for the thermal variation of the coefficient of magnetisation agree with the theory of magneton. The values obtained for n, the number of magnetons, with manganous chloride or oxide are not whole numbers, but the differences between the atomic moments are very near to one magneton. All the chlorides give a positive constant of the molecular field. W. G.

Simple Electric Heater for the Evaporation of Liquids. EDUARD MOSER (*Zeitsch. angew. Chem.*, 1920, **33**, 300).—A mixture of coarse carbon powder and coarse fire-clay particles is placed in a shallow fire-clay vessel 20 cm. in diameter. Two iron electrodes are clamped inside the vessel and opposite each other, the lower ends of the electrodes making contact with the carbon mixture; the resistance of the latter is such that a current of 220 volts and 4 amperes yields a heat suitable for the evaporation of liquids. The resistance increases after the apparatus has been used for some time, but may be decreased by the addition of fresh carbon in small quantity. W. P. S.

The Isothermals of Hydrogen. L. HOLBORN (*Ann. Physik*, 1920, [iv], **63**, 674—680).—The isothermals of hydrogen at temperatures of 0°, 50°, and 100°, and at pressures between 20 and 100 atm., were determined. The results may be expressed in the following formulæ. The unit of pressure was that of a column of mercury of 1 metre at 0° under the normal gravity, $g=980{\cdot}665$ cm./sec.^{2}. The unit of volume was the volume of the gas under this normal pressure. Within the limits of experimental error, amounting to a few parts in ten thousand, the isotherms for 50° and 100° were linear; that for 0° showed a slight deviation from a straight line, but never to a greater extent than 1 in 1000.

0°: $pv=0{\cdot}99918+0{\cdot}00082094p+0{\cdot}0000003745p^2$.
50°: $pv=1{\cdot}18212+0{\cdot}00089000p$.
100°: $pv=1{\cdot}36506+0{\cdot}00091400p$.

The results may be expressed as functions of $1/v$:

0°: $pv=0{\cdot}99918+(0{\cdot}00081613)/v+(0{\cdot}000001220)/v^2$.
50°: $pv=1{\cdot}18112+(0{\cdot}0010505)/v+(0{\cdot}000001015)/v^2$.
100°: $pv=1{\cdot}36506+(0{\cdot}0012450)/v+(0{\cdot}000001240)/v^2$.

J. R. P.

Specific Heats. M. PADOA (*Atti R. Accad. Lincei*, 1920, [v], **29**, ii, 198—202).—The author advances the view that the behaviour of solids with respect to specific heat should find its best interpretation in their chemical characters, these including the affinity. Application to this theme of the supposition, supported

by the author's experimental data (A., 1919, ii, 51, 96; 1920, ii, 85), that the binding of the atoms in crystals is due to chemical forces, and therefore to primary and secondary valencies, leads to the conclusion that the amplitude of the thermal movement of the atoms, and consequently also the heat-content and its derivative with respect to temperature, that is, the specific heat, should depend essentially on: (1) the solidity, (2) the directions, and (3) the number, of the linkings between the atoms.

Since the stability and the molecular complexity increase in passing from simple to complex molecules, it seems that a continually increasing affinity is rendered available for the construction of the crystalline edifice; confirmation of this is furnished by the fact that polymerides always melt at higher temperatures than the corresponding compounds with simple molecules. According to these considerations, both the solidity of the internal linkings of any single molecule and that of the external linkings uniting the various molecules of a chemical individual should tend to diminish the specific heat. That such diminution of the specific heat with polymerisation does actually occur is shown by the results of the author's measurements of the specific heats of cyanamide, dicyanamide, and melamine; silver cyanate and cyanurate; sodium cyanate and cyanurate; lævoglucosan, starch, and cellulose; cyanuric acid and cyamelide. For instance, the value of the specific heat for starch or cellulose is only about one-half of that for lævoglucosan. From the molecular heat, a mean atomic heat for each of the constituent atoms of a compound may be calculated, and this atomic heat, in contradiction of the law of Neumann and Kopp, decreases markedly as polymerisation increases The different values of the specific heat for the isomeric cyanuric acid and cyamelide indicates, as was to be expected, that, other conditions being equal, the specific heat varies with the arrangement of the valencies in a molecule. T. H. P.

Specific Heat at Low Temperatures. Paul Günther (*Ann. Physik*, 1920, [iv], **63**, 476—480).—The specific heat of sodium, antimony, and lithium hydride has been determined at various low temperatures by means of a slightly modified form of the Nernst and Schwers' apparatus (Günther, *ibid*, 1916, **51**, 828). The following values have been obtained for the atomic heat in the case of the elements and the molecular heat in the case of lithium hydride: sodium, 87°, 5·26; 89·7°, 5·29; 91·5°, 5·40; 105·2°, 5·58; 108·0°, 5·64; 121·9°, 5·67; and 124°, 5·67; antimony, 80·4°, 5·19; 81·6°, 5·06; 85·6°, 5·22; 92°, 5·33; 98·1°, 5·47; lithium hydride, 74·0°, 0·674; 83·2°, 0·925; 90·5°, 1·217; and 292·7°, 8·177. The temperatures in all cases are in degrees absolute. The atomic heat and molecular heat values are compared with the values calculated by means of Debye's formula (A., 1912, ii, 1134), and in most cases a good agreement between the two sets of results is found. J. F. S.

The Theoretical Determination of the Vapour-pressure Equation for any Substance from the Density and Coefficient of Expansion at a given Temperature (below the Boiling Point). I. Carbon. J. J. VAN LAAR (*Rec. trav. chim.*, 1920, **39**, 647—655).—Applying the formula $\log p = -A/T - B\log T + CT + \ldots + C$ (compare A., 1920, ii, 287), the author obtains for carbon the equation $\log^{10} p = -47120/T - 3\log^{10} T + 20{\cdot}24$, from which he calculates for carbon $T_e = 5200°$ and $T_c = 7800°$ abs., and the value for the triple point of carbon as 3900° abs. The value of p_c is 2500 atm. (approx.). W. G.

A Method of Measuring Low Vapour Pressures, with its Application to the Case of 2:4:6-Trinitrotoluene. ALAN W. C. MENZIES (*J. Amer. Chem. Soc.*, 1920, **42**, 2218—2221).—A McLeod gauge is immersed in a constant-temperature bath and connected with a bulb immersed in a second bath. The apparatus is exhausted, and nitrogen admitted to a small pressure. The pressure increase on heating the bulb is found. The material is placed in the bulb and the operation repeated, vapour being prevented from diffusing to the gauge by cooling a portion of the connecting tube. From the increase of pressure, the vapour pressure of the substance may be calculated.

The vapour pressures of trinitrotoluene, m. p. 80·5°, dried, but not specially purified, are represented in a table, from 80° to 102°, in the original. The observed pressures were: 0·046 mm. at 81·6°, 0·067 mm. at 90·1°, and 0·120 mm. at 102·6°. [See *J. Soc. Chem. Ind.*, 1921, 28A.] J. R. P.

Heat Changes in the Formation of "Nitrolime." PAUL DOLCH (*Zeitsch. Elektrochem.*, 1920, **26**, 455—459).—Making use of Nernst's heat theorem, the author has calculated the heat changes occurring in the formation of calcium cyanamide on the assumption of a complete equilibrium. The calculations are based on Thompson and Lombard's experimental data (*Met. Chem. Eng.*, 1910, **8**, 682). It is shown that the heat of combination of nitrogen with calcium carbide is $Q = 58700$ Cal. per gram of carbide. The equilibrium curve for the formation is deduced, and it is shown that the calculated values lie within the limits set by the uncertainty of the value of Q. The calculated values differ very much from the values of Thompson and Lombard at high temperatures, and it is suggested that the divergences may be due to a change in the phases of the system. J. F. S.

The Heat of Vaporisation of a Liquid at Low Temperatures. E. ARIÈS (*Compt. rend.*, 1920, **171**, 986—989. Compare A., 1920, ii, 585).—Polemical. A reply to Bruhat (A., 1920, ii, 732). W. G.

A Substitute for Thoulet's Solution. A. THIEL and L. STOLL (*Ber.*, 1920, **53**, [*B*], 2003).—For the determination of the specific

gravity of organic substances by Retger's suspension method, an aqueous solution of lead perchlorate can be used in place of the more expensive Thoulet's solution (mercury–potassium iodide) or Rohrbach's solution (mercury–barium iodide). The perchlorate solution is prepared by saturating commercial perchloric acid with lead carbonate and evaporating to the saturation point. The saturated solution at 15° is a mobile liquid, D^{15} 2·6, and contains 78% of lead perchlorate. E. H. R.

Forces in Surface Films. I. Theoretical Considerations. II. Experimental Observations and Calculations. III. The Charge on Colloids. A. M. WILLIAMS (*Proc. Roy. Soc.*, 1920, [*A*], **98**, 223—234).—The effects of accessibility of surface and of adsorption on the apparent specific volumes of finely divided solids are discussed. Observations are in agreement with the theory of these effects. The true specific volume of a specimen of charcoal, which gave the apparent values 0·51 and 0·46 in water and chloroform, respectively, was evaluated as 0·67 c.c. per gram. The attractive pressure in the surface film on the charcoal was calculated to be of the order of 10,000 atm., whilst the internal pressure of charcoal itself was estimated as of the order of 50,000 atm. These compressive forces may give rise in the adsorption layer to a diffusion potential difference of the magnitude observed in the case of suspensoids. J. R. P.

Molecular Transformations in Thin Films on the Surface of Water. HENRI LABROUSTE (*Ann. Physique*, 1920, [ix], **14**, 164—238).—The effect of the following substances in forming films on the surface of water was studied: ethyl ether vapour, turpentine vapour, benzene, toluene, xylene, ethyl ether, light petroleum, turpentine, triolein, oleic acid, trilaurin, tribenzoin, salol, benzophenone, trimyristin, camphor, benzoic acid, lauric acid, vanillin, paraffin, palmitic acid, stearic acid, cetyl palmitate, cetyl alcohol, gamboge, cyclamine, and various powders. Betol, benzophenone, and azobenzene, added in solution, do not spread into films. The changes of certain films with time were investigated. J. R. P.

Theory of the Viscosity of Heterogeneous Systems. W. R. HESS (*Kolloid Zeitsch.*, 1920, **27**, 1—11).—After a discussion of the formulæ put forward by Einstein (*Ann. Physik*, 1906, [iv], **19**, 297) and Hatschek (A., 1911, ii, 19, 98) to represent the viscosity of heterogeneous systems, the author develops the formula $\eta_s=\eta(1-K)$, in which η_s is the viscosity of the suspension, η that of the dispersion medium, and K the total volume of the suspended particles, that is, $(1-K)$ is the volume of dispersion medium per unit volume of the suspension. Putting this formula into words, it states that the work used when a suspension flows through a tube of given dimensions is inversely proportional to the true cross-section of the liquid. The formula is tested by means of some experimental results on the viscosity of suspended blood corpuscles. It is found that the total volume

of the suspended particles must be multiplied by a factor slightly greater than unity to give the volume of the particles which is functioning in the process. The need of this factor is justified by the existence of a "dead space" in the liquid behind the solid particles, and this is taken account of in the formula by substituting $K' = aK$ in the original formula, where a is the factor mentioned above.

J. F. S.

Theory of the Viscosity of Heterogeneous Systems. A. EINSTEIN (*Kolloid Zeitsch.*, 1920, **27**, 137).—The author points out that he modified the formula for the viscosity of suspensions put forward in 1906 (*Diss.*, Berlin), which had the form $\eta' = \eta(1 + \phi)$, where ϕ is the total volume of the suspended particle in a liquid of viscosity η, to $\eta' = \eta(1 + 2{\cdot}5\phi)$ (*Ann. Physik*, 1911, **4**, 34). This change is apparently not well known (compare Hess, preceding abstract).

J. F. S.

The Importance of Adsorption in Analytical Chemistry. I. M. KOLTHOFF (*Pharm. Weekblad*, 1920, **57**, 1510—1529).—Although adsorption phenomena are comparable in many respects to those due to lowering of surface tension, the latter is not always the cause of the former, which generally proceeds in accordance with the law $x/m = ac\,.\,1/n$, where x/m is the quantity of adsorbed material per gram of adsorbent, c is the end concentration, and a and $1/n$ are constants; this law may be regarded as in essence chemical, and based on the known laws of mass action.

In qualitative analysis, adsorption is of importance (1) for the collection of small quantities of material, as in the use of filter paper to collect lead in water analysis; (2) when traces of material may be lost by adsorption, generally on filter paper; and (3) for the removal of objectionable substances, as in the decolorising of liquids. In quantitative analysis, the same phenomena may appear. Adsorption of material, either by the filter paper or by a precipitate, may lead to grave errors in analysis. Thus filter paper strongly adsorbs various heavy metals from neutral solution. Quantitative determinations of the amounts so adsorbed show that lead is very strongly adsorbed, copper and silver to a smaller degree. After filtration of mercuric chloride, the ash-content of the filter paper, as determined by ignition, appears less, probably by volatilisation of the adsorbed mercury compound. According to Ostwald, it should be possible, by sufficiently numerous washings, almost completely to remove an adsorbed substance from filter paper, but this is not in agreement with the author's results.

The adsorbing action of filter paper, at least as far as electrolytes are concerned, is to be ascribed to the ash-content, which functions as a calcium-permutite, in which the calcium ion may be replaced by another positive ion, which thus becomes fixed in the paper. This view is supported by the fact that anions are not adsorbed, whilst if the solutions be sufficiently concentrated, equivalent quantities of positive ions are taken up, these quantities corresponding with the alkalinity of the ash. Acid solutions, that

is, hydrogen ions, prevent adsorption. By quantitative examination, it was found that metals of the alkalis and alkaline earths were not adsorbed, whilst the order for the quantities adsorbed from 100 c.c. of solutions of various common metallic salts containing 10 mg. per litre were as follows: $Pb^{\cdot\cdot}$ 90%, $Hg^{\cdot\cdot}$ and $Mn^{\cdot\cdot}$ 80%, $Cu^{\cdot\cdot}$ 70%, $Cd^{\cdot\cdot}$ 60%, $Ni^{\cdot\cdot}$ 40%, $Co^{\cdot\cdot}$ and $Ag^{\cdot}$ 30%, $Zn^{\cdot\cdot}$ 10—20%, $Fe^{\cdot\cdot\cdot}$ nil. Alkaloids were also strongly adsorbed from neutral solutions. The capillary action of filter paper is obviously of great importance in this connexion, but the author does not accept the conclusion that this is explained by its adsorptive power. In some cases, the capillary working is purely physical, as in the case of white of egg and colloidal aluminium hydroxide, which act by blocking the pores. Positive colloids are difficult to filter; they give a precipitate in the pores of the paper, which is negatively charged. Filter paper will, in fact, impart a negative charge to positive metal oxide sols by repeated filtration.

The capillary action of filter paper in causing liquids to ascend is more complex. Ostwald's expression, $s=kt^m$, in which s is the height reached after the time t, and k and m are constants, m being less than unity, is found to hold for many cases. k is a characteristic constant, and corresponds with the speed of penetration for the paper. From the theoretical work of Lucas, the same result is deduced. Since the drawing up of dissolved substances is analogous to that of pure liquids, the former cannot be ascribed to adsorption. Schmidt has put forward the expression $h/H=k/K$, where h and H are the heights reached by the solute and the solvent respectively, and k and K are the constants in Ostwald's expression. From this law, when k and K are known, the concentration of a solution can be determined by the heights to which the solute and solvent, respectively, are drawn up.

Skraup and his pupils have studied these phenomena for acid solutions of different concentrations. Strong acids ascend less than water, weak acids nearly as high. Skraup arrived at the equation $(H-h)/h\,.\,c-K$, where H and h are the heights reached by the water and solute, respectively, and c is the concentration. The author finds the equation $L=aC^{1/n}$, where L is the ratio $h:H$, C is the concentration, and a and n constants, to hold for a large number of cases, notably hydrochloric, hydrobromic, and oxalic acids, and for the strong bases. The weak acids and bases are irregular, and no constants can be determined.

There are many abnormal cases; hydrogen fluoride and hydrogen sulphide behave as strong acids. By later work, Skraup has shown that the anion of the acid ascends as high as water, only the hydrogen ion being restrained; the author ascribes this to the alkalinity of the ash. Non-electrolytes suffer no restraint, and ascend as high as water. Salts behave as though highly hydrolysed. Salts of the alkalis and alkaline earths also ascend as high as water, but salts of the heavy metals are restrained. The rates of ascent vary considerably, and in some cases the solute is found to have higher concentrations the higher it ascends. The speed

of ascent is much diminished in presence of alcohol or glycerol, but the final height is not affected, except in the case of sodium hydroxide.

The author finds that whilst in neutral solution salts of the heavy metals are drawn up to a much smaller height than water, if the solutions be acidified, the salts reach to the same height as the water. This is regarded as further proof that the ascent is not a pure adsorption phenomenon. S. I. L.

Adsorption Compounds. III. R. HALLER (*Kolloid Zeitsch.*, 1920, **27**, 30—34. Compare A., 1918, ii, 259; 1919, ii, 184).—The adsorption complex produced when a suspension of lead hydroxide is shaken with cotton-red 4 B. extra,

$$C_{12}H_6Me_2(N_2\cdot C_{10}H_5[NH_2]\cdot SO_3Na)_2,$$

has been treated with various reagents, some of which, acetic acid and sodium hydroxide, convert the lead hydroxide into a soluble compound, and others, hydrogen sulphide, hydrochloric acid, sulphuric acid, potassium chromate, and hydriodic acid, convert it into an insoluble compound. The object of the experiments was to ascertain in what way the adsorption complex is changed when the substrate is changed. The experiments show that the solution of the adsorbent completely destroys the complex. Chemical changes of the adsorbent, in the sense that a new, insoluble compound is produced, cause the destruction of the complex when the new product has no adsorptive action on the original dye, but when the new product exerts an adsorptive action on the dye, a new complex is formed without any apparent dissociation of the original complex. In the latter case there is an exception in the case of lead iodide. This substance does not adsorb cotton-red, but when the lead hydroxide is converted into lead iodide, a new complex is actually formed. J. F. S.

Relationship between Adsorption and the Dissolved Condition. I. Adsorption of Amino-acids, Polypeptides, and Egg-albumin by Animal Charcoal. EMIL ABDERHALDEN and A. FODOR (*Kolloid Zeitsch.*, 1920, **27**, 49—58).—Adsorption by charcoal from aqueous solution is theoretically considered, and it is shown that in the experiments on which the experimental law and the adsorption isotherm are based, dilute solutions were used with small quantities of the adsorbent, that is, although dilute aqueous solutions were employed, equilibrium was reached with concentrated charcoal solutions. It is therefore held that simple adsorption laws will only be obtained when the adsorbent is treated in the same way as the liquid solution. This is to be brought about by using a large amount of charcoal, so large that a further addition will not affect the partition of the dissolved substance between the liquid solvent and the solid adsorbent. From experiments on the adsorption of *l*-leucine and glycyl-*l*-leucine from aqueous solution (A., 1919, ii, 49, 50), it is shown that $x/(a-x)=k$ represents the process, in which a is the initial con-

centration, x the amount adsorbed, and k a constant. This relationship holds only when an excess of charcoal is used. From the above and other experimental results (*loc. cit.*), it is shown that the adsorption of amino-acids, polypeptides, and many other substances by charcoal occurs according to the partition law. The adsorption by charcoal is to be ascribed to chemical forces, since if this is not true, the adsorption of mixtures cannot be explained.

J. F. S.

A Capillary Phenomenon. H. BECHHOLD (*Kolloid Zeitsch.*, 1920, **27**, 229—233).—The author, in attempting to impregnate unglazed porcelain with an insoluble silver or copper salt, proceeded in the following way. The porcelain was placed in a vessel and the air removed by a pump, a solution of silver nitrate or copper sulphate was then admitted, and the porcelain saturated. This was then dried and again freed from air, and ammonium thiocyanate or sodium hydroxide, respectively, admitted; this was absorbed by the porcelain, and the insoluble salt formed. On drying and breaking the porcelain, it was found that the insoluble salts were not to be found in the interior of the mass, but were found entirely at the edges. On saturating porcelain, and, while still moist, breaking it, the absorbed salt was found to be uniformly distributed through the mass, so that the absorbed material travels to the edges on drying. The same phenomenon is found in agricultural earth which has been treated with mineral fertiliser; after long periods of drought, the mineral fertiliser is found in greater concentrations at the surface than elsewhere. Experiments are described on earth which had been uniformly mixed with 2% solutions of sodium chloride, barium chloride, and aluminium sulphate respectively, and kept for eleven months in a shaded place. On analysis, the salt concentration was found to have increased in the surface layers. Hypotheses to explain the phenomenon are put forward and discussed. J. F. S.

Degree of Association of the Molecules of Binary Salts in Non-aqueous Solutions. P. WALDEN (*Kolloid Zeitsch.*, 1920, **27**, 97—101).—A general discussion of the association of the molecules of binary salts in non aqueous solvents. Making use of previously published work on the conductivity and molecular weight of tetraethyl-, tetrapropyl-, and tetra*iso*amyl-ammonium iodides in a large number of solvents, it is shown that a connexion exists between the degree of association, x, and the dielectric constant, ϵ, of the solvent, in the sense that the degree of association increases with falling dielectric constant, and reaches its highest value with solvents of the smallest dielectric constant. Thus tetra*iso*amylammonium iodide in benzene solution (*DE* 2·3) and carbon tetrachloride solution (*DE* 2·2) behaves like a colloid and has a very large molecular weight, since it does not raise the boiling point of these solvents even when present in quantities up to 14%. Hence the conclusion is drawn that highly polymerised binary

electrolytes may pass through all conditions of molecular complexity, from simple ions to highly complex molecules typical of colloids, by dissolving them in suitable solvents. Solvents with dielectric constants >2 exercise a protecting action on highly polymerised molecules, and maintain the size at a point which is characteristic of colloids. Hence the author asserts that it is not so much a colloid type of material that has to be considered, but rather a colloidal condition of matter. J. F. S.

An Apparatus for Continuous Dialysis or Extraction. HUBERT MANN (*J. Biol. Chem.*, 1920, **44**, 207—209).—The apparatus consists essentially of a flask, a condenser, and a vessel so arranged that the system may be exhausted, and that the liquid placed in the apparatus may be caused to circulate by means of continuous evaporation and condensation. The apparatus has the advantages that a small amount of solvent can be used for the extraction of a large amount of material, and that the process may be carried out under reduced pressure. J. C. D.

Solubility. IV. Solubility Relations of Naphthalene and Iodine in the Various Solvents, including a Method for Evaluating Solubility Data. JOEL H. HILDEBRAND and CLARENCE A. JENKS (*J. Amer. Chem. Soc.*, 1920, **42**, 2180—2189. Compare A., 1916, ii, 578; 1918, ii, 36; 1919, ii, 392).—The solubilities of a substance in solvents where no molecular changes are involved, when plotted as $\log N$ (N=molar fraction) against $1/T$, give a family of approximately straight lines converging to the melting point of the solute, where $N=1$. The position of these lines corresponds with the internal pressures of the solvents, and is approximately predictable from them.

When solvation exists, the solubility will be greater than would otherwise be expected, but the temperature-coefficient will be smaller. The temperature-coefficient of solubility will be greatest for substances differing most in internal pressure.

The results are illustrated by the solubility of naphthalene and iodine in various solvents.

The solubilities of iodine in various solvents have been measured.

Solubilities of Iodine in Grams per 100 *Grams of Solution.*

	0°.	25°.	35°.	50°.
Heptane	0·6176	1·702	2·491	4·196
Carbon tetrachloride	0·6877	—	2·603	4·351

	25°.	30°.	35°.	40°.	45°.	50°.	56·64°.
Benzene	14·09	16·10	17·90	20·05	22·78	25·51	28·26

Violet solutions of iodine gave the family of curves expected, whereas the brown solutions showed the deviations expected for solvate formation. J. R. P.

Solubility. V. Critical Solution Temperatures of White Phosphorus with Various Liquids. JOEL H. HILDEBRAND and THEO. F. BUEHRER (*J. Amer. Chem. Soc.*, 1920, **42**, 2213—2218).—Critical temperatures of mixing of liquid phosphorus with other substances have been determined as follows: decane, >300°; chlorobenzene, 264°; naphthalene, 202°; phenanthrene, 200°; *p*-dibromobenzene, 163°; carbon disulphide, −6·5°. These figures confirm predictions made in previous papers (A., 1918, i, 62; 1919, ii, 392). J. R. P.

Crystallographical Observations on Atomic Structure. HERMANN TERTSCH (*Sitzungsber. Akad. Wiss. Wien*, I, **129**, pp. 24; from *Chem. Zentr.*, 1920, iii, 659—660).—The crystals even of the elements cannot, in general, be regarded as point lattices, since the individual components, the atoms, do not uniformly exhibit spherical symmetry, and also the symmetry of the components does not generally coincide with that of the lattice. The properties of Bohr's model do not indicate spherical symmetry of the atoms, although the discordance is not so marked if the path of the electrons is not regarded as lying in a plane. The crystalline forms of the several elements are compared with the object of elucidating regularities or detecting approximations in the individuals to spherical symmetry. The latter is found to be shown to a greater extent by the heavier than by the lighter elements. Special emphasis is laid on the possibility that the path of the electrons lies on the surface of a sphere, and the distribution of the electrons in such a system, and the type of symmetry which is thereby necessary for atomic structure, are discussed. The author further examines the possibility of coincidence between the hypothetical distribution of electrons thus derived (atomic symmetry) and the observed lattice symmetry. It is shown that a rational connexion exists between atomic symmetry and crystalline form. This is readily demonstrated for twenty-three of the forty-three crystallographically known elements; for four others, a suitable arrangement of electrons can be given provisionally, whilst for the remaining sixteen it is not at present possible to put forward a satisfactory hypothesis concerning the relationship of atomic and crystalline forms without resorting to very problematical suppositions. H. W.

Rôle of Water of Crystallisation and the Structure of Alums. L. VEGARD (*Ann. Physik*, 1920, [iv], **63**, 753—758).—Polemical with Schaefer and Schubert (A., 1919, ii, 516). Conclusions as to the situation of the atoms in space lattices cannot be drawn directly from the constitutional formulæ or from the indications of measurements of residual rays ("Reststrahlen"); the connexion between constitution, crystal structure, and the mechanism of residual rays must be established by determinations of the space lattice. It is incorrect to draw from the results of Schaefer and Schubert the conclusion that water of crystallisation enters into the

structure of the space lattice in the same manner as the other constituents of the salt. The opposite conclusion could equally well be drawn. J. R. P.

Relations between Crystallographic Phenomena and Constitution of some Organic Compounds. A. SCHLEICHER (*J. pr. Chem.*, 1920, [ii], **100**, 49—56).—A theoretical paper in which the relationship between constitution and crystalline form of organic compounds is discussed. J. K.

Limited "Free Rotation" from the Point of View of the Theory of Symmetry. A. SCHLEICHER (*J. pr. Chem.*, 1919, [ii], **100**, 57—64).—The ideas developed in the previous paper (preceding abstract) are applied to the cases of compounds, for example, *s*-dimethylsuccinic acid, which exist in two forms in consequence of suppression of free rotation. J. K.

The Structure of Precipitates. SVEN ODÉN (*Svensk Kem. Tidskr.*, 1920, **32**, 108—110; from *Chem. Zentr.*, 1920, iii, 705). —The increase in the size of the particles of barium sulphate is but little due to the difference in solubility of the small and large crystals. The change in the nature of the precipitate which is induced by heating depends on the fact that this is usually performed in a solution containing much free electrolyte, which catalyses the irreversible transformation of the secondary aggregates primarily formed. Reversibility appears to depend on the degree of hydration of the particles which are attached to one another by means of their aqueous envelopes. If for any reason the latter is broken or the original degree of hydration is too slight (as with metallic particles), so that the particles come within the range of their cohesive or adhesive forces, the transformation becomes irreversible. H. W.

The Velocity of Flocculation of the Selenium Sol. I. The Flocculation by Potassium Chloride. H. R. KRUYT and A. E. VAN ARKEL (*Rec. trav. chim.*, 1920, **39**, 656—671).— An extension of work already published (A., 1919, ii, 140). The variation of the number of particles with the time is, in principle, represented by Smoluchowski's formula (A., 1917, ii, 297), $\Sigma\nu=(\Sigma\nu)_0/(1+t/T)$, in the case of rapid flocculation, but in the case of slow flocculation this relation is not satisfied. Similarly, Smoluchowski's theory as to the relationship between the velocity of flocculation and the concentration of the sol holds good for rapid flocculation, but in the case of slow flocculation the phenomena are much more complicated. W. G.

The Coagulation of Gold Hydrosols by Electrolytes. The Change in Colour, Influence of Temperature, and Reproducibility of the Hydrosol. JÑANENDRA NATH MUKHERJEE and BASIL CONSTANTINE PAPACONSTANTINOU (T., 1920, **117**, 1563—1573).

Colloidal Adsorption. ARTHUR MUTSCHELLER (*J. Amer. Chem. Soc.*, 1920, **42**, 2142—2160).—With gelatin as a typical reversible colloid and zinc sulphate as electrolyte, the following results were found: (i) With small additions of electrolyte (less than 0·28 molar), the migration velocity of the anions was zero and that of the cations unity, so that the cations alone seem to carry the current; the anions alone are adsorbed, and only near the point where the colloid is neutral is there a small adsorption of cations; the colloid particles migrate to the negative pole, indicating that they are positively charged; the viscosity increases as the charge of the particles approaches the zero point; the rate of swelling of gelatin increases as the concentration of electrolyte approaches 0·28 molar.

(ii) When the concentration of electrolyte is 0·28 molar, the migration velocity of the anions is zero and that of the cations exactly unity. The electrolytic deposit on the cathode is smooth and pure. The anions and cations are adsorbed by the colloid in proportion to their mobilities; as the anions generally migrate faster than the cations, they are more adsorbed. The velocity of motion of the colloid particles in the electrostatic field is zero; the viscosity is a maximum; the rate of swelling of gelatin is a maximum.

(iii) With concentrations of electrolyte greater than 0·28 molar, the migration velocity of the anions is increased, and that of the cations is decreased, as the addition of electrolyte is increased. The adsorption of positive and negative ions continues until the particles assume a negative charge, when the cations are adsorbed in greater proportion. The particles migrate to the anode and are negatively charged, the viscosity of the solution gradually decreases as the charge on the particles increases; the rate of swelling of gelatin decreases as the concentration of electrolyte added increases. At molar concentration of zinc sulphate, gelatin is precipitated J. R. P.

Investigation of Sodium Oleate Solutions in the Three Physical States of Curd, Gel, and Sol. MARY EVELYN LAING and JAMES WILLIAM MCBAIN (T , 1920, **117**, 1506—1528).

Colour Change of Congo-rubin with Time and the Influence of Electrolytes and Protecting Colloids. HEINRICH LÜERS (*Kolloid Zeitsch.*, 1920, **27**, 123—136).—The main factors which influence the colour change of Congo-rubin have been quantitatively studied. It is shown that the change is affected by the concentration of added electrolytes according to similar laws to those found for gold sols by Zsigmondy ("Kolloidchemie," 2nd edition, 353—354). A region of slow coagulation and one of rapid coagulation exist in which very small changes in the concentration of the electrolyte cause great changes in the time over which the colour change occurs. It is shown in the case of the three electrolytes, potassium chloride, magnesium chloride, and cerous chloride,

that the Whetham-Robertson coagulation rule is not followed. With a constant electrolyte concentration, the time of colour change of Congo-rubin is inversely proportional to its concentration. The time of change increases rapidly with the viscosity of the solution. Both these results are to be explained by the assumption that the coagulation of the discharged particles is controlled by their velocity of diffusion. The course of coagulation of a given sol under the influence of varying quantities of electrolytes is very similar within the limits of the present experiments. During coagulation an increase in viscosity takes place, which has not as yet been quantitatively explained. The protecting action of gelatin on the colour change of Congo-rubin is varying, depending on the concentration of the electrolyte. A minimum protecting action is obtained with moderate concentrations of electrolytes, but the action increases rapidly with larger or smaller concentrations. All internal changes of condition, such as are brought about by ageing, the influence of anions, and the action of tannic acid, have a very marked action on the protecting action of gelatin. This fact is evidence in support of the protecting sheath hypothesis of the protecting action, according to which the action is not due merely to the presence of the protecting colloid, but rather to close relationship between the protecting and protected colloids. The experiments all point to the fact that the change in the colour of Congo-rubin from red to blue under the influence of neutral salts, is a typical colloid-chemical phenomenon, and is very similar to the changes observed with gold sols. J. F. S.

Colloid Chemical Basis of the Kinetics of Fermentation. A. Fodor (*Kolloid Zeitsch.*, 1920, **27**, 242—249).—The author has derived expressions which represent the kinetics of ferment action. Two cases are considered, (i) where the ratio F/S is small, F is the free surface of the ferment, and S the concentration of the substrate, and (ii) where the ratio F/S is large. In the first case the velocity of reaction is given by $dx/dt=k(a-x)^{1/n}$, where a is the initial concentration of the substrate, x the amount changed in time t, n the constant of the adsorption isotherm $c_1/c_2^{1/n}=\text{const.}$, and k a constant. On integration the above equation gives $k=-n/(n-1)t\{\sqrt[n]{(a-x)^{n-1}}-\sqrt[n]{a^{n-1}}\}$. Inserting the value $n=\frac{1}{2}$, the equation becomes $k=1/t(\sqrt{a}-\sqrt{(a-x)})$, and this equation has been found to represent the hydrolysis of glycyl-*l*-leucine by yeast extract in the presence of a hydrogen-ion concentration varying between $P_H=6{\cdot}27$ and $8{\cdot}81$. In the second case, $dx/dt=k(A-x)^{1/n}$, where A is the concentration of the ferment and $1/n=1$ or <1. This, on integration, yields the formula $t=1/(1-n)k\{A^{(1-n)}-[A-x]^{(1-n)}\}$. J. F. S.

"Gilding" of Amicrons of some Colloids. Gösta Börjeson (*Kolloid Zeitsch.*, 1920, **27**, 18—27).—The author has made use of the fact that solutions of gold amicrons can be used as crystallisation nuclei of other sols in the determination of the

degree of dispersity of sols with particles so small that they may not be counted in the ultramicroscope (Zsigmondy, A., 1906. ii, 679). The method consists in the preparation of a very highly disperse sol of the metal under investigation; a measured volume of this is added to a solution of gold chloride and hydrogen peroxide. The gold sol is formed on the amicrons of the highly disperse sol used, and from the rate of sedimentation the diameter of the gilded amicrons is deduced, and hence the number and radius of amicrons originally present. The formula $r_k = r\sqrt[3]{k/p}$ is used in the calculation, in which r_k is the radius of the amicron, r that of the sedimenting hydrosol, k the weight of the amicron, and p the total weight of the particles of the hydrosol. In this way the radius of the amicrons of alco-sols prepared by the Bredig method has been determined for the following metals: gold, $r=4\cdot9\ \mu\mu$; cadmium, $r=9\cdot9\ \mu\mu$; zinc, $r=9\cdot8\ \mu\mu$; silver, $7\cdot1$—$18\cdot0\ \mu\mu$, this value increasing with time; copper, $r=5\cdot0$—$7\cdot8\ \mu\mu$. In the case of tin and bismuth, the particles can be seen in the ultramicroscope and their radii directly determined, the values obtained by the present method and the direct method are in fair agreement. Measurements have also been made with the sols of arsenic sulphide and antimony sulphide. J. F. S.

Colour Behaviour of Congo-rubin. R. HALLER (*Kolloid Zeitsch.*, 1920, **27**, 188—195).—The colour changes of Congo-rubin have been studied. It is shown that Congo-rubin solutions change in colour from red to blue, by the addition of acid, sodium carbonate, barium hydroxide, and neutral salts, and the red colour may be recovered by the addition of alcohol. Further, a 1% solution of a bluish-violet colour on heating becomes red. If to 1 c.c. of the cold solution and to 1 c.c. of a warm solution 10 c.c. of water and 1 c.c. of magnesium sulphate solution (12·03 grams per litre) are added, the cold solution is immediately turned blue, whilst the warmed solution only becomes blue after some time. Loose strands of cotton, when coloured with a 1% solution of Congo-rubin by placing in the cold solution, slowly raising to the boiling point and then allowing to cool, take on a ruby-red colour of medium intensity. If the process is carried out in the presence of sodium chloride, the colour of the solution becomes blue, but on heating changes to red, and again the cotton is dyed red. On washing the cotton with distilled water it slowly changes to blue. If similar experiments are carried out with filter paper or cotton fabric, the colour is red, but except at the edges it does not change to blue on washing. This behaviour is explained by the presence of two phases of different dispersity in the solution; the one of greater dispersity is red and the other of smaller dispersity blue, and these are differently adsorbed by the cotton fibres. This is well seen with vicose silk, the red colour being visible through the blue. This view is confirmed by treating a 1% Congo-rubin solution with a large excess of sodium chloride and filtering; a red filtrate is obtained with a violet precipitate. The precipitate can be got into colloidal solution again in water, and is again treated with sodium

chloride and filtered, when again a red filtrate is obtained and a blue residue. On repeating this process five times a blue residue is finally obtained, which on washing gives a colourless filtrate. Consequently, the colloid has been separated into two parts of different dispersity. A number of experiments are made with Congo-rubin-*G*, which is found in many respects to be markedly different from Congo-rubin, although isomeric with it. The whole of the experiments point to the fact that the colour changes are colloid-chemical in character, and are due to the formation of a second phase of different dispersity from the original phase by the addition of electrolytes. J. F. S.

Apparatus for Ultra-filtration according to Gans. LEONOR SARLO VILLEGAS (*Contr. Estad. Ciencias* [*La Plata*], *Ser. mat. fis.*, 1919, **2**, 415—418; from *Chem. Zentr.*, 1920, iv, 613—614).—A simple, transportable apparatus for ultra-filtration is described, which is particularly suitable for colloidal solutions of metals. Solutions of silver, hæmoglobin, albumin, and milk, amongst others, have been investigated, and crystalloids which, for example, have been mixed with arsenic, have been separated quantitatively. The apparatus consists of a glass cylinder (9 cm. high and 7 cm. in diameter), provided with bronze disks as bases, which hermetically seal the cylinder by interspersed rubber rings. The upper disk has two openings, one for the manometer and the other for the pressure pump. At the bottom, between rubber ring and bronze disk, a thin, metallic plate is clamped which serves as support for the ultra-filter. Platinum is a suitable material for the plate, but nickel or aluminium can be used; it is provided with a number of holes, 1 mm. in diameter, to permit the passage of the filtrate. The following method is used in preparing the filter. Gun cotton (12·5 grams) is thoroughly moistened with alcohol, and as much ether is added as is required to bring the volume of the mixture to 500 c.c. A portion of this solution is brought on to a glass plate and dipped in water, when the mixture has set; a gentle movement of the plate causes the thin film to become detached. Filters of this type are permeable to colloids. In general, permeability depends greatly on the acidity, and is markedly increased by the presence of small amounts of acetic acid (about 0·5%). Collodion filters have also been investigated; variations of the solution have been examined, and very satisfactory results are recorded with mixtures of equal parts of alcohol and ether. The permeability of the collodion filters for colloids does not depend solely on the amount of acetic acid added, but also on the time which has elapsed since the addition was made. A collodion filter to which as much as 6% of acetic acid has been added gives a completely permeable filter if it is used immediately after being prepared. H. W.

Double Ternary Systems with Miscibility Gaps in the Liquid and Solid States. I. and II. C. MAZZETTI (*Atti R. Accad. Lincei*, 1920, [v], **29**, ii, 150—153, 194—198).—I. The

author considers first the case of the double ternary system, in which only one binary system, corresponding with one side of the square, exhibits liquid and solid miscibility gaps with eutectics, the other three pairs forming continuous series of mixed crystals, and the surface ζ_l being below ζ_s. Diagrams of the system are shown. When two of the binary systems present solid and liquid miscibility gaps and eutectics, various cases occur: either these binary systems give rise to two pairs of gaps which have no mutual effect, in which event the condition of affairs is similar to that in which only one of the binary systems shows gaps; or the solid gaps alone, or else both solid and liquid gaps, fuse to a single gap.

II. Attention is given to a double ternary system in which three of the binary systems exhibit solid and liquid miscibility gaps and eutectics; in this case there appear in the system two compound gaps represented by two singular triangles, one of three liquids and one of three solids. The case of four miscibility gaps in the system is also considered. T. H. P.

Equilibria of Reciprocal Salt Pairs, Sodium Chloride, Magnesium Sulphate and Sodium Sulphate, Magnesium Chloride at 25°. SHIRŌ TAKEGAMI (*J. Tokyo Chem. Soc.*, 1920, **41**, 831—868. Compare Blasdale, A., 1920, ii, 237).—Solubilities of the four salts and the equilibrium of two salts having a common ion were investigated; that of magnesium chloride and sulphate was especially studied, ascertaining the formation of four hydrates of magnesium sulphate, proposed by van't Hoff. In the equilibria of reciprocal salt pairs, nine solid phases exist: Na_2SO_4; $Na_2SO_4,10H_2O$; NaCl; astracanite; $MgSO_4,7H_2O$; $MgSO_4,6H_2O$; $MgSO_4,5H_2O$; $MgSO_4,4H_2O$; and $MgCl_2,6H_2O$. Compositions of the solution saturated with one, two, or three salts were as follows, where a, b, and m are expressed by the formula:

$$100mH_2O,aNa_2(100-a)Mg,bCl_2(100-b)SO_4.$$

Solid phase.	a.	b.	m.
NaCl	100	100	18·02
$MgSO_4,7H_2O$	0	0	18·31
$Na_2SO_4,10H_2O$	100	0	28·51
$MgCl_2,6H_2O$	0	100	9·41
NaCl; Na_2SO_4	100	80·40	15·96
Na_2SO_4; $Na_2SO_4,10H_2O$	100	51·31	18·03
NaCl; $MgCl_2,6H_2O$	1·08	100	9·32
$MgSO_4,7H_2O$; astracanite	32·72	0	13·69
Astracanite; $Na_2SO_4,10H_2O$	50·14	0	13·97
$MgSO_4,7H_2O$; $MgSO_4,6H_2O$	0	86·81	12·08
$MgSO_4,6H_2O$; $MgSO_4,5H_2O$	0	91·10	10·15
$MgSO_4,5H_2O$; $MgSO_4,4H_2O$	0	93·60	9·56
$MgSO_4,4H_2O$; $MgCl_2,6H_2O$	0	93·58	9·11
$Na_2SO_4,10H_2O$; Na_2SO_4; astracanite	57·95	13·88	13·66
Na_2SO_4; NaCl; astracanite	73·38	70·66	15·06
NaCl; astracanite; $MgSO_4,7H_2O$	37·97	49·71	13·96
NaCl; $MgSO_4,7H_2O$; $MgSO_4,6H_2O$	3·77	87·04	11·92
NaCl; $MgSO_4,6H_2O$; $MgSO_4,5H_2O$	0·68	91·12	10·03
NaCl; $MgSO_4,5H_2O$; $MgSO_4,4H_2O$	0·25	93·7	9·5
NaCl; $MgSO_4,4H_2O$; $MgCl_2,6H_2O$	0·24	93·77	9·27

K. K.

The Determination of the Number of Independent Constituents. Dubreuil's Rule; the Action of Water on a Mixture of Salts. C. Raveau (*Compt. rend.*, 1920, **171**, 913—916).—Dubreuil's rule (A., 1920, ii, 742) is discussed, and Rengade's work (A., 1917, ii, 451) on the purification of salts by fractional crystallisation is discussed in the light of this rule.

W. G.

The Separation of Two Salts having a Common Ion. A. Th. Schlœsing (*Compt. rend.*, 1920, **171**, 977—981).—Curves are plotted showing the weight of each salt in 1 kilo. of solution saturated with respect to the two salts at different temperatures. The solution containing the two salts, which it is required to separate, is analysed, and from these results and the curves previously plotted it is possible to determine the temperature at which the solution should be evaporated, so that only one salt will separate out. W. G.

Periodic Precipitation and Coagulation by Electrolytes. Franz Sekera (*Kolloid Zeitsch.*, 1920, **27**, 28—30).—A theoretical paper, in which the author considers the causes of periodic precipitation and coagulation of colloidal solutions in layers by means of electrolytes. J. F. S.

The Phase Rule. Henry Le Chatelier (*Compt. rend.*, 1920, **171**, 1033—1038).—A critical survey of Gibbs' phase rule and of the criticisms of it which have appeared in recent years. The criticisms urged against it are briefly replied to. W. G.

Radiation as a Factor in Chemical Action. Irving Langmuir (*J. Amer. Chem. Soc.*, 1920, **42**, 2190—2205).—In order to explain the close similarity between the Arrhenius equation for the velocity of chemical reactions and the Wien radiation law (namely, that the logarithms of the reaction velocity and of the intensity of monochromatic radiation are both linear functions of the reciprocals of the absolute temperature), and also to explain the fact that the velocity of a unimolecular reaction is independent of the collision frequency of the molecules, it has been assumed that molecules can take part in chemical reactions only after they have become activated, and that the activation is brought about by the absorption of nearly monochromatic radiation. There seems to be ample evidence in support of the activation of molecules, but the radiation hypothesis does not seem to rest on such a firm foundation.

There are two decisive tests of the validity of the radiation hypothesis: (1) the reacting substance must absorb radiation of the frequency required to produce activation, and there must therefore be an absorption band which includes this frequency; (2) the total amount of radiant energy absorbed must be sufficient to supply the heat of activation of the molecules, which is calculated from the temperature-coefficient of the reaction velocity.

Examination of the available data indicates that there is little evidence that absorption bands occur which include the frequency corresponding with the activation. In the dissociation of phosphine, nitrous oxide, nitric oxide, carbonyl chloride, phosphorus and arsenic, the activation frequencies lie within the range of the visible spectrum, although the gases are all colourless.

The data for phosphine show that the energy required for activation of 1 c.c. at 948° abs. is 4×10^{10} times greater than the amount which could be supplied by radiation from 1 sq. cm. of surface at this temperature. Also, when the intensity of the radiation is increased enormously (as by using daylight), the reaction velocity does not show a corresponding increase.

Experiments with nitrogen peroxide, hydrogen, and iodine vapour show that the heat conductivity of dissociating gases is many times greater than that of similar gases which do not dissociate. The increase in heat loss from small wires, due to the dissociation of the surrounding gas, is often more than ten times the total energy radiated from the wire. On the basis of the radiation hypothesis, however, the dissociation entails an absorption of radiation, and could produce only a decrease in heat loss from the wire. These experiments furnish conclusive evidence against the radiation hypothesis.

The similarity between the Arrhenius and Wien equations results from the fact that both reaction velocity and radiation are fundamentally dependent on phenomena involving probability. Both equations can be deduced from the same statistical law: $P = ce^{-E/kT}$, where P is the probability that, in any large number of molecules in thermal equilibrium at the temperature T, a given molecule shall have an energy lying between E and $E+dE$. It is shown that, unless the law of conservation of energy has also only a statistical significance, the activation energy must be derived from internal energy of the molecules, which exists at the zero of absolute temperature. The very fundamental difficulties involved in this conclusion are of the same nature as those encountered in the theory of the photoelectric effect, thermionic emission, and other phenomena involving quantum relations. J. R. P.

The Laws Governing the Propagation of Combustions. L. Crussard (*Technique moderne*, 1920, **12**, 243—250, 295—301).—This is a mathematical discussion of gaseous combustions, from the standpoint of Hugoniot's law, covering detonations and deflagrations; stability of propagations including propagation of simple mechanical perturbations, velocities of combustions, and of sound, rôle of calorific exchanges, flame and preflame, intrinsic stability, examination of the different systems of combustion from the point of view of intrinsic stability, extrinsic stability and instability, encounter of the flame and mechanical shock, detonations from the point of view of extrinsic stability, compressions and deflagrations; the explosion wave; propagations in their relations to the liveliness of combustions, examination of the essential data including reaction

velocity, temperature of inflammation and diagrams of combustion; the law governing deflagration including the study of the preflame and the flame; the law of combustion, the order of the velocity of propagation in the usual mixtures, velocity of propagation in the most rapid mixtures, rôle of the temperature of origin, limits of aptitude for the propagation of deflagration and tests of the general formula for the velocity of propagation; and finally a discussion of the constitution of flame. CHEMICAL ABSTRACTS.

Behaviour of Explosive Mixtures of Gases at Low Pressures. A. STAVENHAGEN and E. SCHUCHARD (*Zeitsch. angew. Chem.*, 1920, **33**, 286—287).—Mixtures of methane and air were sparked in a U-tube of 250 c.c. capacity, with limbs about 2·5 m. long and 12 mm. in diameter. The level of mercury in the apparatus afforded a measure of the pressure to which the gas was subjected. The results showed that explosive mixtures of gases have a critical pressure below which they no longer ignite. The intensity of an explosion decreases with the fall in the pressure. By carrying out the experiment in the dark it is possible to determine from the character of the flash whether the explosion is complete, or whether there has only been partial combination. For example, 5 c.c. of the gas under a pressure of 40 mm. of mercury showed a flash of about 30 mm. in length, and 6% of the gas combined, whilst 9·5 c.c. of the gas under a pressure of 61 mm. of mercury showed a flash 150 mm. long and 30% of the gas combined. A slow, flameless combination takes place at pressures below the critical point, the amount of such combination increasing with the nearness of the pressure to that point. The critical pressure depends on the nature and proportions of the gaseous constituents, the moisture, and the initial impulse. The occurrence of an explosion in a closed space does not prevent the possibility of a second explosion, without any subsequent change having been made in the proportions of the mixture. The lower the pressure at the first explosion, or the greater the reduction in the pressure by that explosion, the greater will be the possibility of a second explosion (compare Mason and Wheeler, T., 1918, **113**, 45). C. A. M.

Velocity of Decomposition of High Explosives in a Vacuum. II. Trinitrophenylmethylnitroamine (Tetryl). ROBERT CROSBIE FARMER (T., 1920, **117**, 1603—1614).

The Transformation of Ammonia into Carbamide. C. MATIGNON and M. FRÉJACQUES (*Compt. rend.*, 1920, **171**, 1003—1005).—The authors obtain the expression

$$\log p = -1511/T + 5{\cdot}6 \log T - 9{\cdot}4,$$

where p is expressed in atmospheres, for the value of the equilibrium pressure of ammonium carbamate at different temperatures in an enclosed space, such that the volume occupied by the gaseous phase is as small as possible. W. G.

The Velocity of the Diazotisation Reaction as a Contribution to the Problem of Substitution in the Benzene Nucleus. J. Böeseken, W. F. Brandsma, and H. A. J. Schoutissen (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 249—266).—The influence of substituents in the nucleus on the rate of diazotisation of aromatic amines was studied in connexion with the general problem of substitution in the benzene ring. The diazotisations were carried out at 0° in solutions containing two millimols. of amine per litre. At convenient intervals, samples of the solution were removed and coupled in alkaline solution with Schäffer's salt at 0°, and the extent to which diazotisation had proceeded was estimated by a colorimetric comparison of the samples, assuming that diazotisation was complete in six hours. In each case the reaction was bimolecular, and the velocity constants found were as follows: aniline, $100K = 0·0965$; *o*-toluidine, 0·0928; *m*-toluidine, 0·137; *p*-toluidine, 0·0687; *m*-xylidine, 0·0886; *o*-chloroaniline, 0·483; *o*-bromoaniline, 0·450; *o*-iodoaniline, 0·453; *m*-chloroaniline, 0·135; *m*-bromoaniline, 0·142; *m*-iodoaniline, 0·1515; *p*-chloroaniline, 0·153; *p*-bromoaniline, 0·129; *p*-iodoaniline, 0·1505; aniline-*o*-sulphonic acid, 0·966; aniline-*m*-sulphonic acid, 0·107; aniline-*p*-sulphonic acid, 0·247; anthranilic acid, 1·761; *m*-aminobenzoic acid, 0·145; *p*-aminobenzoic acid, 0·521; and *m*-nitroaniline, 1·13. Except in the toluidines and xylidine, the velocity of the reaction is considerably increased by introducing substituents into aniline. The effect is greatest when the substituent is in the ortho-position to the amino-group, and weakest in the meta-position. The velocity increases with the negative character of the substituent. E. H. R.

Alkaline Hydrolysis of Esters of Symmetrical Homologues of Oxalic Acid. Anton Skrabal and Erna Singer (*Monatsh.*, 1920, **41**, 339—400).—The authors have investigated the hydrolysis of esters of symmetrical homologues of oxalic acid in aqueous and aqueous-alcoholic solution by means of sodium carbonate and hydroxide, and have measured the velocities of the two stages of the reactions.

In concentrated solution, the esters of the normal acids from oxalic to sebacic acid exhibit normal behaviour, the reaction being a simple stage reaction of the second order. The ratio between the reaction constants of the two consecutive reactions has its maximum value for oxalic acid, afterwards falls rapidly, and then slowly approaches the limiting value, 2, for the higher homologues. Further, this ratio is not independent of the concentration, but for one and the same dicarboxylic acid diminishes apparently to the same limit, 2, as the concentration is increased. This limit is far from attained with the lower homologues, but is practically reached with such esters as those of azelaic and sebacic acids. These results are similar to those obtained by Chandler (A., 1908, ii, 467), who found that the ratio between the two electrolytic dissociation constants of the free dicarboxylic acids approaches the limiting

value, 4, as the molecular weight of the acids and the concentration increase. The two ratios are, indeed, symbatic, and reach their limiting values simultaneously, and the two limiting values correspond with the independent, uninfluenced reaction of the two identical reactive groups.

The ratio 2 as the limit for the kinetic constants, and the approximation to this limit as the concentration and velocity increase, are easily interpreted according to the "regulation" law (A., 1912, ii, 33; 1916, ii, 606), which states: If alteration of a parameter of the velocity of reaction (such as the nature or concentration of the reacting substances, the medium, the nature and concentration of the catalyst, the temperature, or the illumination) produces increase of this velocity, influences come into play in the form of alteration of the constants, or of the form of the time-law, which are antagonistic to such increase; thus the actual regulated velocity lags behind that which would be expected in absence of regulation. The ratio between the constants is the ratio of two comparable velocities. If the latter are subject to regulation, as the velocity increases, the more rapid reaction is relatively more highly retarded than the slower one, the ratio approaching the value 2; when the latter is reached, the two groups react equally quickly, and beyond that stage both velocities are retarded to the same extent, and the ratio hence undergoes no further change.

From alterability of the constant-ratio follows, necessarily, that of the velocity-coefficients. On hydrolysis of ethyl malonate and succinate in dilute solution, a decline of the constants of the second order is, indeed, observed.

Whilst increase of the coefficients is observed, or, more accurately, suggested, in the case of the normal acids only in dilute solution, the diminution in the coefficients with esters of the alkylmalonic acids is so considerable that the reaction cannot be calculated as of the second order. This diminution is greater in dilute than in concentrated solution, and greater with the dialkylmalonic esters, which are hydrolysed slowly, than with those of the monoalkylmalonic acids, which are hydrolysed more rapidly, and still greater than with the malonic esters, which undergo hydrolysis with great rapidity. T. H. P.

Influence of Lead on the Catalytic Activity of Platinum. EDWARD BRADFORD MAXTED (T., 1920, **117**, 1501—1506).

Catalytic Studies. VII. Catalysis of Hydrogen Peroxide by Iodine Ions. E. ABEL (*Monatsh.*, 1920, **41**, 405—421).—The author has already shown (A., 1908, ii, 939) that the catalysis of hydrogen peroxide by hydrogen ions, often cited as a typical catalysis (Bredig and Walton, A., 1903, ii, 282), may be represented as a special case of a much more general catalysis of the peroxide which results from the co-operation, or, more accurately, the antagonism, of the two reactions: (1) $H_2O_2 + I_2 \longrightarrow 2H^{\cdot} + 2I' + O_2$, and (2) $H_2O_2 + 2H^{\cdot} + 2I' \longrightarrow I_2 + 2H_2O$. The kinetics of the second of these reactions has been long worked out

(Noyes and Scott, A., 1896, ii, 158; Brode, A., 1901, ii, 443; 1904, ii, 718), and the author has recently (*Zeitsch. physikal. Chem.*, 1920, **95**, 513) investigated the kinetics of reaction (1).

The conditions for the initiation of the catalysis of hydrogen peroxide by iodine ions are now formulated, and the result arrived at tested by means of the experimental material formerly obtained (*loc. cit.*). For a given case of this catalysis, the position of the spontaneous catalytic equilibrium and the time relations leading to its attainment are calculated and discussed. T. H. P.

The Temperature-coefficient of the Decomposition of Hydrogen Peroxide by Fat Catalase. E. NORDEFELDT (*Biochem. Zeitsch.*, 1920, **109**, 236—240).—The constant A of Arrhenius's formula has been determined for the decomposition of hydrogen peroxide by fat catalase at various temperatures. The figures obtained did not differ much from those obtained by Senter for blood catalase. S. S. Z.

Catalysis. VIII. NIL RATAN DHAR [with A. K. DATTA and D. N. BHATTACHARYA] (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 299—307).—The paper deals with the effect of catalysts on the reaction between ferrous ammonium sulphate and silver nitrate and on the atmospheric oxidation of sodium sulphite solutions, and with the hydrolysis of methyl acetate by oxalic and picric acids in presence of potassium oxalate and sodium picrate, respectively. The reaction between ferrous ammonium sulphate and silver nitrate is bimolecular and very rapid at 0°, with a small temperature-coefficient. After a time, an equilibrium is set up, due to the reducing action of silver on ferric nitrate:

$$Ag + Fe(NO_3)_3 \rightleftharpoons AgNO_3 + Fe(NO_3)_2.$$

The reaction is accelerated by acids, including nitric, sulphuric, citric, tartaric, acetic, and carbonic, but not by boric acid or phenol. Manganese salts and potassium nitrate have a retarding effect.

A large number of organic substances act as negative catalysts with respect to the atmospheric oxidation of sodium sulphite. Organic acids have practically the same effect as their sodium salts, and benzoic, oxalic, and salicylic acids have a greater negative effect than the weaker organic acids. Quinol was the most powerful negative catalyst discovered. The temperature-coefficient of the reaction, which is 2 between 25° and 40°, was not affected by the negative catalysts. Organic substances probably act as negative catalysts by diminishing the concentration of the sulphite ions, with which they combine to form stable complexes.

Potassium oxalate in increasing concentration steadily diminishes the velocity-coefficient of hydrolysis of methyl acetate by oxalic acid, whilst in the case of picric acid the velocity constant first increases to a maximum value and then falls off with increasing concentration of sodium picrate. These results may be explained by considering, besides the diminution of hydrogen-ion concentration due to the increased concentration of the negative ion common

to the acid and salt, the increased dielectric constant and ionising power of the solvent caused by the dissolved salt. E. H. R.

Catalysis. IX. Thermal and Photochemical Reactions. NIL RATAN DHAR (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 308—312).—It is shown that many reactions having large temperature-coefficients are sensitive to light, and hence it is considered that sensitiveness to temperature and to light influences have a common cause. The reaction between iodine and potassium oxalate is accelerated by light, the most active portion of the spectrum being the indigo near the violet end. Mercuric chloride and potassium oxalate in sunlight undergo the reaction:

$$2HgCl_2 + K_2C_2O_4 = 2KCl + 2CO_2 + 2HgCl.$$

This reaction is also induced by the light from a carbon arc, a quartz mercury vapour lamp, or an arc between electrodes of thoria and zirconia. Ammonium cupric oxalate is decomposed by tropical sunlight, but not by the above artificial sources of light. Uranium salts are general positive catalysts in photochemical reactions, whilst manganese salts are general negative catalysts in both light and dark reactions. The author's conclusions on the relation between thermal and light effects are supported by Perrin's hypothesis that all chemical reactions are induced by radiations (A., 1919, ii, 177). E. H. R.

Catalysis. X. Explanation of some Abnormally Large and Small Temperature-coefficients. NIL RATAN DHAR (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 313—318).—The reaction between iodic acid and potassium iodide in dilute solution is very rapid at 0°, and the temperature-coefficient cannot be determined, but is practically equal to unity. In presence of sodium and magnesium sulphates, slightly less iodine is liberated at higher than at lower temperatures, and the temperature-coefficient appears to be negative. This is due to hydrolysis of the sulphate at higher temperatures, with formation of OH' ions, which react with the iodine liberated. In presence of ammonium and zinc sulphates, the reaction apparently has a positive temperature-coefficient, the explanation being that at higher temperatures these salts produce $H^{\cdot}$ ions, which are active in liberating iodine. The abnormally large temperature-coefficient of the reaction $3I_2 + 6OH' = 5I' + IO_3' + 3H_2O$ in presence of sodium carbonate and hydrogen carbonate is due to hydrolysis of the carbonates. A number of other temperature-coefficients are similarly explained.

E. H. R.

A New World of Chemical Compounds. P. P. VON VEIMARN (*Ann. ecole mines de l'Oural*, 1919, **1**, 1—7).—The assertion that atomic and molecular forces are vectorial is identical with the principle that chemical forces have a vectorial character. Hence a change from gas–fluid to solid–crystal is a chemical process. Chemically homogeneous crystals are the simplest representatives of homochemical compounds, that is, compounds in which affinity

reveals itself between similar atoms, and all liquids and gases must be considered as disperse systems of this vectorial polymer-crystal. If such crystals are chemical compounds, it follows, of necessity, that the valency of atoms of all elements cannot be less than 6 in order to give a three-dimensional form. Differences in combining power with hydrogen or oxygen atoms lie largely in the size of the surface of atoms and in the ease with which hydrogen atoms in their mobility may form doublets, thus hindering the concentration of hydrogen atoms round the atom of the element. Molecules of hydrogen, fluorine, nitrogen, etc., are examples of the most stable homochemical compounds, and show by the tendency to remain as doubled atoms the magnitude of the intensity of homochemical forces. In chemical compounds the atoms have not lost, but only more or less changed, the properties they have in the free state. A study of colloidal synthesis has given rise to the principle that any matter gives in corresponding conditions homochemical compounds with any other matter, in case of there being common atoms or atomic groups Dispersoidal parasitism with homochemical compounds thus has rendered possible the preparation of colloidal solutions of great stability and high concentration.

CHEMICAL ABSTRACTS.

Arrangement of Atoms in some Common Metals. A. W. HULL (*Science*, 1920, **52**, 227 –229) —A preliminary note on the results of X-ray analysis of various metals. Calcium has a face-centred cubic arrangement, each atom being surrounded by 12 equi-distant atoms Titanium is centred cubic, each atom being surrounded by 8 others. Zinc is hexagonal close-packed and elongated 14% in the direction of the hexagonal axis. Cadmium is like zinc, with an elongation of 16%. Atoms of indium are arranged in a face-centred tetragonal lattice resembling a cubic close packing, except that it is elongated 6% in the direction of one of the cubic axes. Ruthenium has an arrangement similar to zinc and cadmium, but there is a contraction of 3% in the direction of the hexagonal axis. Palladium, iridium, and platinum are like calcium; tantalum is like tungsten, iron, chromium, and titanium.

CHEMICAL ABSTRACTS.

A Convenient Form of the Periodic Classification of the Elements. C. R. NODDER (*Chem. News*, 1920, **121**, 269).—A modification of Harkin's spiral as a representation in one plane. Two plane spirals are used, for the odd and even series, respectively, corresponding radii being parallel and numbered similarly.

J. R. P.

Nature of Valency. ALFRED BENRATH (*Zeitsch. angew. Chem.*, 1920, **33**, 289—290).—The following conception of valency is suggested to reconcile the theory of Berzelius with observed facts. The reactions attributable to the main valencies of an element are characterised by the combination of atoms with other atoms of opposite polarity, and their replacement by other atoms with similar

action, whereas by-valencies are characterised, in the main, by the combination of compounds, and rarely by the combination of atoms of similar polarity. Hence by the valency of an element should be understood only the number of main valencies not altered by the action of by-valencies. The main valencies must be either positive or negative, and if an element appears to exert valencies of opposite polarity, the explanation is to be found in the presence of by-valencies. The valency towards hydrogen, or (+) valency, is distinguished from the valency towards oxidising agents, or (−) valency, and these cannot be simultaneously active in the same element, since hydrogen combines with oxidising elements to form inactive compounds, such as water or hydrogen chloride, which can only enter into combination with by-valencies. The valency of an element in a compound can only be changed by oxidation or reduction, and not by reactions involving the by-valencies. C. A. M.

Angle of Slope. A New Physical Constant. A. LANGHANS (*Kolloid Zeitsch.*, 1920, **27**, 101—123).—The angle of slope is that angle at which a particle of material can just maintain its position. The author describes six methods by which this angle may be measured. One of these consists in filling a metal cylinder, which is cut into two pieces, with the powdered substance, then, on removing the metal cylinder, the powder will fall and produce a cone, which may be measured. The angle which the side of the cone makes with the horizontal is the angle of slope. This angle has been determined for ninety substances; the results are given in tables, together with the specific gravity and the size of the particles. The angle is shown to decrease with increasing specific gravity, and it also depends on the viscosity of the powder and the size of the particles. J. F. S.

The Accuracy obtainable with Varnished Weights. E. H. VOGELENZANG (*Chem. Weekblad*, 1920, **17**, 453).—Aluminium weights varnished over to varying thicknesses have been exposed to atmospheres saturated to various known degrees of moisture, and the alteration in weight examined. It is found that no perceptible change occurs, and such weights are thought to be suitable for use even with the microbalance, since the humidity of the air in the case can be kept almost constant. S. I. L.

The Metallic Elements of the Ancient Chinese. G. WANG (*Science* [China], 1920, **5**, 555—564).—The Chinese early discovered a number of chemical facts and a knowledge of the chemical character of some natural phenomena. The discoveries were never scientifically developed, and the surviving accounts are mystical and obscure. The author gives an account of the metallurgy of early China. CHEMICAL ABSTRACTS.

The Metallic Compounds of the Ancient Chinese. G. WANG (*Science* [China], 1920, **5**, 672—684).—The author divides the history of chemistry in China into: (1) the alchemical period; (2) the period of iatro-chemistry; (3) the modern period. China has just emerged from the second period. A large number

of the common inorganic compounds were known and employed as medicines. Investigation has been made of the reactions involved in the old methods of preparing these compounds.

CHEMICAL ABSTRACTS.

Inorganic Chemistry.

Influence of Chloride on the Solubility of Chlorate and its Dependence on Temperature. JEAN BILLITER (*Monatsh.*, 1920, **41**, 287—295).—In spite of the very considerable increase in the solubility of chlorates with rise of temperature, but little separation of crystals occurs when a hot solution, saturated with chlorate and very rich in chloride, is cooled. Investigation shows that the solubility of sodium chlorate per unit volume of water or sodium chloride solution increases linearly with rise of temperature. The diminution produced in the solubility of sodium chlorate by addition of sodium chloride increases as the temperature rises, the extent of the increase being especially great for high concentrations of the chloride. Thermodynamic considerations indicate that the heat of solution of sodium chlorate in concentrated sodium chloride solutions should diminish as the temperature rises, and that the solubility of sodium chloride is diminished by addition of the chlorate more at high than at low temperatures. T. H. P.

Polychroism of Colloidal Sulphur. RUDOLF AUERBACH (*Kolloid Zeitsch.*, 1920, **27**, 223—225).—Colloidal sulphur is capable of exhibiting various colours depending on the degree of dispersion. The colour changes can be shown by adding phosphoric acid to sodium thiosulphate solution when first a weak turbidity appears, which is followed by a yellowish-blue opalescence, and then the colour observed by transmitted light passes slowly through yellow, green, red, violet, and blue, and finally the sulphur is precipitated. The whole process occupies twenty minutes. The following quantities are recommended for demonstration of the process: (i) For demonstration in a test-glass: 10 c.c. of $N/20$-sodium thiosulphate are treated with 0·1 c.c. of phosphoric acid (D=1·70) in 9·9 c.c. of water. (ii) For demonstration by lantern projection on a white screen: 15 c.c. of $N/20$-sodium thiosulphate solution are treated with 0·1 c.c. of phosphoric acid (D=1·70) in 4·9 c.c. of water. It follows, therefore, that disperse systems of dielectric substances can show polychromatic colours just in the same way as metallic disperse systems. J. F. S.

Preparation of Sulphur and Sulphuric Acid from Sulphates of the Alkaline Earths. E. H. RIESENFELD (*J. pr. Chem.*, 1920, [ii], **100**, 115—158).—I. *Reduction of Kieserite by Carbon*

[with ALFRED FABER].—A review of the literature on the utilisation of magnesium sulphate leads to preference being given to the proposal of Precht (*Chem. Ind.*, 1881, **4**, 350) to reduce kieserite by means of charcoal according to the equation $2MgSO_4 + C = 2MgO + 2SO_2 + CO_2$. Experiments showed that, at least in part, reaction occurs according to the equation $MgSO_4 + C = MgO + SO_2 + CO$. Thus the solid residue always contained sulphur when less than one atomic proportion of carbon to magnesium was employed, the best results being obtained with the proportion 1 : 1 at 750—850° or 1·5 : 1 at 950°. Under these conditions, the sulphur was obtained almost entirely as sulphur dioxide, with a little free sulphur. Contrary to what might be expected, reduction was not complete when greater proportions of carbon were used, probably because the molten sulphide then produced surrounded the sulphate and protected it from further action.

II. *Reduction of Gypsum and Anhydrite by Carbon* [with HANS FELD].—The reaction between gypsum and carbon sets in below 500°, but very slowly, and is fairly rapid from about 700° upwards. Under suitable conditions, pure calcium sulphide was obtained, approximately according to the equation $CaSO_4 + 3C = CaS + CO_2 + 2CO$. Similarly, from strontium and barium sulphates, the sulphides were produced, the different behaviour of magnesium sulphate being accounted for by a consideration of the heats of reaction. The composition of the gaseous phase in the former cases is controlled by the $C:CO:CO_2$ equilibrium, but in the case of magnesium sulphate this is disturbed by the action of sulphur dioxide on carbon monoxide.

III. *The Calcium Sulphate–Carbonate Equilibrium* [with (Frl.) ITALIENER and (Frl.) M. HESSE].—The equilibrium $CaS + H_2O + CO_2 \rightleftharpoons CaCO_3 + H_2S$ cannot be utilised for the disposal of calcium sulphide obtained by the above reduction, since at temperatures, for example, 700°, at which it is sufficiently rapidly attained, it favours the formation of calcium sulphide to a very considerable extent.

IV. *Reduction of Gypsum and Anhydrite by Gases* [with MARGARETE HESSE].—Gypsum was reduced by methane according to the equation $CaSO_4 + CH_4 = CaS + CO_2 + 2H_2O$. Below 800°, dehydration of the gypsum alone occurred, but at 800—1000° quantitative reduction appears possible if the action be sufficiently prolonged. Above 1100°, some calcium oxide was produced, probably as a result of the reaction, $CaS + H_2O = CaO + H_2S$. The deduction from this equation that excess of steam would favour complete removal of sulphur was confirmed by experiments at 1200° and 1300°. Partly in consequence, however, of dissociation of hydrogen sulphide and partly by its reaction with water vapour (compare Randall and Bichowsky, A., 1918, ii, 159), the sulphur was obtained almost entirely as sulphur dioxide or elementary sulphur, the latter predominating when only a slight excess of water was employed.

V. *Decomposition of Calcium Sulphide by Steam and the Direct*

Conversion of Gypsum and Anhydrite into Oxide [with MARGARETE HESSE].—Experiments on the action of steam on calcium sulphide justified the assumption above of its intermediate formation, the amounts of sulphur dioxide and elementary sulphur produced being in agreement with the previous results. It must therefore be possible to convert calcium sulphate directly into the oxide by treatment with carbon and steam, and experiment showed this to occur at 1200°, but more than six times as rapidly at 1300°. Owing to the reducing action of carbon monoxide and hydrogen on sulphur dioxide, elementary sulphur predominated in the product, only 50% being obtained as the dioxide, even when 850 times the theoretical proportion of steam was employed. J. K.

Date of the Discovery of Tellurium and Bromine. PAUL DIERGART (*Zeitsch. angew. Chem.*, 1920, **33**, 299—300).—Tellurium was first discovered in 1782, or the beginning of 1783, by F. J. Müller of Hermannstadt; T. Bergmann of Upsala in 1783 concluded that a new element had been isolated The element was discovered independently by Kitaibel in 1789, and the discovery was confirmed by Klaproth of Berlin in 1798, this investigator giving the name of "tellurium" to the element. Bromine had been isolated previous to 1826, but not recognised as a new element; it is mentioned by Bérard in a paper appearing in the *J. chim. Med.*, August, 1826; whilst Balard, *Ann. chim. phys.*, [ii], **32**, 337, August, 1826, gave the name "bromine" to the element.
W. P. S.

The Reaction between Chlorine and Ammonia. II. WILLIAM A. NOYES and A. B. HAW (*J. Amer. Chem. Soc.*, 1920, **42**, 2167—2173. Compare A., 1901, ii, 601).—Anhydrous ammonia and anhydrous chlorine react to form nitrogen trichloride and ammonium chloride, $4NH_3 + 3Cl_2 = 3NH_4Cl + NCl_3$. A considerable proportion of the trichloride always decomposes into chlorine and nitrogen, either directly or by interaction between the trichloride and ammonia. The ratio of the number of molecules of chlorine to the number of molecules of ammonia may be varied between wide limits without affecting appreciably the ratio between the number of molecules of ammonia and the number of molecules of ammonium chloride. This ratio is 4 to 3. The chlorine reacts primarily with the ammonia, but only to a trifling extent, or not at all, with the solid ammonium chloride which is formed. The reaction was carried out with the dry substances without a solvent, and also in presence of carbon tetrachloride or pentane.
J. R. P.

The Reaction between Chlorine and Ammonia. III. Probable Formation of Trichloro-ammonium Chloride. WILLIAM ALBERT NOYES (*J. Amer. Chem. Soc.*, 1920, **42**, 2173—2179).—Dry hydrogen chloride converts nitrogen trichloride quantitatively into ammonium chloride. The reaction may occur either in a solution of the trichloride in carbon tetrachloride or

without any solvent. This shows that the decomposition is not a hydrolysis, in the absence of water, and is probably not a hydrolysis in the presence of water.

The action probably consists primarily in the formation of trichloro-ammonium chloride, $\overset{+}{N}Cl_3\overset{-}{H}Cl$, followed by the loss of an atom of positive chlorine with an atom of negative chlorine. The formation of nitrogen trichloride by the action of chlorine on a solution of an ammonium salt appears to be the reverse of the above reaction. Ammonium sulphate is much more suitable than ammonium chloride for the preparation of nitrogen trichloride. Chloroamine and dichloroamine are formed, as well as nitrogen trichloride, by the action of chlorine on ammonium salts. Treatment of an ammonium salt with hypochlorous acid gives a trichloride pure and free from chloro-amines. Nitrogen trichloride may be separated from a solution, in which it is prepared, by a current of air, drying the air and vapour of trichloride by passing through concentrated sulphuric acid, and condensing the trichloride in a U-tube surrounded by a freezing mixture. J. R. P.

Reactions of Salts of Nitrous Acid with Weak Bases. K. A. Hofmann and Gustav Buhk (*Ber.*, 1920, **53**, [*B*], 2165—2171).—It was shown in a previous paper (A., 1920, ii, 487) that carbon monoxide is oxidised by alkali hydroxides in contact with copper with formation of carbonate and free hydrogen, the latter being in the nascent form and having powerful reducing properties. Experiments are now recorded in which a strongly alkaline solution of sodium nitrite was used, but absorption of carbon monoxide was extremely slow. When ammonia was substituted for the strong alkali, absorption was again slow at first, but gradually became more rapid with formation of ammonium carbonate and a gaseous mixture of nitrous oxide, nitric oxide, and nitrogen. The accelerated reaction was found to be due to the formation of the hydrogen carbonate, and it was further found that a solution of sodium nitrite and ammonium hydrogen carbonate reacted with copper at ordinary temperatures with formation of a gas consisting of a mixture of nitrous oxide and nitrogen with very little nitric oxide. This reaction provides a convenient way of preparing nitrous oxide gas for laboratory purposes. Instead of ammonium hydrogen carbonate, ammonium chloride or sulphate can be used. Using 14 grams of sodium nitrite and 22 grams (two molecular proportions) of ammonium chloride in 200 c.c. of water, a total of 1025 c.c. of gas was obtained consisting of 81 c.c. of nitric oxide, 845 c.c. of nitrous oxide, and 99 c.c. of nitrogen. The greater part of the nitric oxide was evolved in the early part of the reaction, whilst the nitrogen content of the gas remained fairly constant throughout.

The reaction is due in the first place to the reduction by the copper of free nitrous acid formed by hydrolysis of ammonium nitrite (produced by double decomposition of the sodium nitrite and ammonium salt), $2HNO_2 + Cu = 2NO + Cu(OH)_2$. The cupric

hydroxide dissolves in the ammonia (a blue colour appears on the surface of the copper), and is reduced by copper to the cuprous form. The cuprous oxide then reduces the nitric oxide further to nitrous oxide, $2NO + Cu_2O = N_2O + 2CuO$. The free nitrogen must be formed by the normal decomposition of ammonium nitrite into nitrogen and water. Magnesium nitrite behaves in a similar manner with copper, but, since it is much less hydrolysed than ammonium nitrite, the reaction proceeds at only about one-sixtieth of the rate. E. H. R.

Transformation of Quartz into Tridymite. ORAZIO REBUFFAT (*Giorn. Chim. Ind. Appl.*, 1920, **2**, 437—438).—The transformation of silica at 1300—1350° from the quartzose form into the form having the lower density, 2·22—2·27, which consists predominantly of tridymite, is facilitated by the presence of small proportions of phosphoric acid. T. H. P.

The Rare Gases of the Natural Gases of Alsace-Lorraine. CHARLES MOUREU and ADOLPHE LEPAPE (*Compt. rend.*, 1920, **171**, 941—947).—The natural gases examined were from petroleum borings, a potash mine, a coal mine, and two mineral springs. The percentages by volume found for the rare gases were argon plus traces of krypton and xenon, 0·0104—1·01%; helium plus traces of neon, 0·0006—1·68%. The constant presence of nitrogen and of the five rare gases was shown in these natural gases of Alsace-Lorraine and, in all but one case, the constant absence of oxygen. The detailed analyses confirm results previously obtained as to the relative proportions of the various rare gases present in natural gases (compare A., 1916, ii, 389, 481). W. G.

The Action of Ozone on Alkali Metals, Ammonia, and Substitution Products of Ammonia. WILHELM STRECKER and HEINZ THIENEMANN (*Ber.*, 1920, **53**, [*B*], 2096—2113).—The action of ozone on solutions of the alkali and alkaline earth metals in liquid ammonia was investigated in the hope of elucidating the constitution of the products obtained by Traube (A., 1912, ii, 844) and others by the action of ozone on concentrated sodium or potassium hydroxide solutions. Although precipitates were obtained which appeared to be ozonides of potassium, sodium, rubidium, cæsium calcium, and barium, these could not be obtained in a pure state on account of by-products formed by the action of ozone on ammonia. The compounds obtained were orange to brown in colour, readily decomposed by water or dilute acids with evolution of oxygen, and giving the hydrogen peroxide reaction with titanium sulphate solution. The ozonides of rubidium and cæsium are the most stable of those prepared.

Quantitative experiments on the action of ozone on liquid ammonia cooled in a carbon dioxide–ether mixture showed that the ozone was completely reduced, the products of the reaction being about 98% of ammonium nitrate and 2% of nitrite. When ozone is first passed into the liquid ammonia, an orange colour appears,

which may be due to the formation of an unstable ozonide. Carefully dried ozone at first acts very slowly on liquid ammonia, but as the reaction proceeds, the water formed has an accelerating influence.

Hydroxylamine hydrate reacts readily with ozone, hydroxylamine nitrate being the sole product of the reaction. The reaction is not complete, excess of ozone being required. Hydrazine hydrate is oxidised by ozone principally to nitrogen and water, only small quantities of hydrazine and ammonium nitrates being formed.

Methylamine and ozone react to form formaldehyde with ammonium and methylammonium nitrate and nitrite. Dimethylamine reduces ozone rapidly and completely, the reaction products identified being nitrate, nitrite, formaldehyde, and formic and acetic acids. The reaction between trimethylamine and ozone is explosive, even at the temperature of an ether–carbon dioxide mixture, and it was necessary to use a 5—10% solution of the base in chloroform to study the reaction. The product of the reaction was trimethylamine oxide, $O{:}NMe_3$, which was precipitated from the chloroform as the hydrochloride, the hydrochloric acid being formed by the oxidising action of ozone on chloroform. E. H. R.

The Action of Fluorine on Potassium Hydrogen Sulphate. E. BRUNNER (*Helv. Chim. Acta*, 1920, **3**, 818—824).—The fact that potassium fluoride has a strong accelerating effect on the electrolytic production of per-salts and hydrogen peroxide might perhaps be ascribed to the little-known oxidising action of fluorine. The author has therefore tested the action of this gas on a saturated solution of potassium hydrogen sulphate and finds that oxidation of the sulphuric acid does take place, but whether the product is persulphuric acid or not is uncertain.

An improved copper cell for the electrolysis of anhydrous hydrogen fluoride is described, and also a small apparatus for the analysis of readily decomposable fluorides by means of the volume of silicon fluoride produced when the sample is heated with dry glass powder and anhydrous sulphuric acid. J. C. W.

The Formation of Additive Compounds between 100% Sulphuric Acid and the Normal Sulphates of the Alkali Metals. JAMES KENDALL and MARY LOUISE LANDON (*J. Amer. Chem. Soc.*, 1920, **42**, 2131—2141).—The freezing points of systems containing sulphuric acid and anhydrous normal sulphates of potassium, sodium, ammonium, and lithium were determined from the eutectic points to 300° The curves showed the existence of the following compounds, omitting compounds of undetermined composition:

With potassium sulphate—(*a*) $K_2SO_4,3H_2SO_4$, m. p. 91·5°. (*b*) K_2SO_4,H_2SO_4, m. p. 218·6°; exists in three modifications with transition points at 182° and 202°.

With sodium sulphate—(*a*) $2Na_2SO_4,9H_2SO_4$; unstable at m. p.

(60° by extrapolation), transition points to the two modifications, of $Na_2SO_4,2H_2SO_4$ occurring at 57° and 58°. (*b*) $Na_2SO_4,2H_2SO_4$; exists in two modifications, both unstable at the melting points, transition to Na_2SO_4,H_2SO_4 occurring at 95° and 109°. (*c*) Na_2SO_4,H_2SO_4, m. p. 186°.

With ammonium sulphate—(*a*) $(NH_4)_2SO_4,3H_2SO_4$, m. p. 48°. (*b*) $(NH_4)_2SO_4,H_2SO_4$, m. p. 146·9°.

With lithium sulphate—(*a*) $Li_2SO_4,7H_2SO_4$, m. p. 13·6°. (*b*) $Li_2SO_4,2H_2SO_4$; unstable at m. p., transition to Li_2SO_4,H_2SO_4 occurring at 50°. (*c*) Li_2SO_4,H_2SO_4; unstable at m. p. (170·5° by extrapolation).

The results are in agreement with the law that the stability of an additive compound increases with the difference in character (that is, the positive or negative nature of the constituent groups) of its components. The salts in sulphuric acid are regarded as weak bases. J. R. P.

Disodium Hydrogen Phosphate Dodecahydrate. Dalziel Llewellyn Hammick, Hector Kenneth Goadby, and Henry Booth (T., 1920, **117**, 1589—1592).

Colour Changes on Coagulating Sulphide Hydrosols. Friedrich Vincenz von Hahn (*Kolloid Zeitsch.*, 1920, **27**, 172—175).—The colour changes brought about by coagulating silver sulphide sols by potassium chloride solutions have been studied. The colour change depends on the concentration of the potassium chloride, and it is only observed between definite fixed limits of concentration; thus with concentrations of potassium chloride below 60 millimols. per litre there is no change, and above 0·22 mol. the colour is always brownish-red. When 5 c.c. of 0·12*N*-potassium chloride are added to 5 c.c. of the silver sulphide sol, a dark yellow coloration appears after five minutes; with 0·14*N*-potassium chloride in similar circumstances a pale leaf-green; 0·16*N* gives an ice-blue colour, 0·18*N* gives blue, 0·20*N* gives violet, and 0·22*N* a dull green. The stability of the colloidal condition at the above-named stages is not great, and in three to four hours the colours become somewhat less intense, and the sol is precipitated. Similar colour effects were found when magnesium sulphate, aluminium sulphate, and hydrochloric acid were used instead of potassium chloride. J. F. S.

Reduction of Sodium Silver Thiosulphate by Hyposulphite. I. Albert Steigmann (*Kolloid Zeitsch.*, 1920, **27**, 249—254).—The reduction of silver sodium thiosulphate by sodium hyposulphite has been studied under a number of conditions. According to Jellinek (A., 1919, ii, 231), sodium hyposulphite decomposes in solution according to the equations $2Na_2S_2O_4 = Na_2S_2O_5 + Na_2S_2O_3$; $Na_2S_2O_5 + H_2O = 2NaHSO_3$. Consequently, solutions of hyposulphite become acid, and the formation of the reduction nuclei in the sodium silver thiosulphate mixtures is thereby greatly reduced. Starting with neutral and alkaline

mixtures of the two reacting solutions, it is shown that the reduction occurs much more rapidly in the alkaline solution than in the neutral solution, since the neutral solution becomes acid during the reaction, owing to the decomposition of the hyposulphite, as indicated above. The silver from alkaline solutions coagulates more rapidly than the blackish-blue silver from acid solutions, which sediments very slowly and yields a precipitate which is deep black in colour. The silver from alkaline solutions is greyish-black, and when rubbed on paper takes on a bronze appearance. The reduction occurs much more rapidly in the presence of a little potassium iodide than in alkaline solutions, and more rapidly still in alkaline solutions containing a little potassium iodide. In all cases, the reduced silver is at first colloidal, which rapidly coagulates. In the alkaline (soda) solutions, the sol remains yellowish-brown in colour until coagulation sets in, but in all other cases the sol becomes reddish-blue very rapidly. Similar reactions are described in the presence of gelatin. J. F. S.

Dispersoid and Colloid Chemistry of Gypsum. I. Wo. Ostwald and P. Wolski (*Kolloid Zeitsch.*, 1920, **27**, 78—92).—The colloidal processes occurring in the setting of burnt gypsum have been investigated by measuring the viscosity of suspensions at various periods of time after the preparation of the suspensions. This method is shown to be a very suitable one for the study of 4—5% suspensions of burnt gypsum. Such suspensions show a strong increase in the viscosity for the first half hour after their preparation. The time–viscosity curves have the shape of an **S**. The concentration of gypsum has a marked influence, in so far as the difference between the initial and final viscosities (hydraulic effect) increases extraordinarily rapidly with the concentration. Temperature plays an important part in the setting of gypsum; the viscosity shows that no setting is taking place at 60°, and very little at 37°, whilst at 0° the increase in viscosity, that is, setting, is very great. Grinding and ageing of the burnt gypsum have a marked effect on the viscosity curve. Freshly ground preparations show a greater hydraulic effect than unground and aged specimens. This is due to the influence of the degree of dispersity. It is shown that more highly dispersed specimens have a greater hydraulic effect than less highly dispersed specimens. The influence of additions of various substances on the setting has also been studied. Thus potassium chloride in concentrations up to $0 \cdot 2N$ accelerates the setting of gypsum, but eventually gives a smaller hydraulic effect than pure water. On the other hand, concentrated solutions of potassium chloride retard the setting of gypsum in suspensions. Acetic acid, $2N$, retards the setting, but gives a somewhat larger hydraulic end effect. Gelatin, 0·2%, and 20% alcohol completely stop the setting of gypsum. J. F. S.

Thallic Nitrite. G. Canneri (*Atti R. Accad. Lincei*, 1920, [v], **29**, ii, 142—146).—Treatment of a suspension of thallium sesquioxide in water with liquid nitrous anhydride, and subsequent

evaporation of the solution, even in the cold under reduced pressure, yields, not thallic nitrite, but thallous nitrate. The latter is also obtained when solutions of thallic sulphate and barium nitrite are mixed in the cold, and the resulting liquid evaporated at low temperature. That thallic nitrite is capable of existence in solution, although it cannot be obtained in the solid condition, is shown by the results of estimations of the total thallium, the thallic thallium, the nitrous nitrogen and the total nitrogen, and by the fact that the nitrogen collected in the estimation of the nitrous acid contains free chlorine, this being liberated by decomposition of the thallic chloride formed from the thallic nitrite and the ammonium chloride added.

Treatment of aqueous thallic nitrite solution with alcohol yields a precipitate of the sesquioxide. In ethereal solution, thallic nitrite is far more stable, and the salt separates in the solid state on evaporation of the solvent; it could not, however, be analysed directly. Decomposition of thallic nitrite, with formation of thallous nitrate, takes place solely in accordance with the equation $Tl(NO_2)_3 \longrightarrow TlNO_3 + N_2O_3$, neither intermediate reduction products nor thallous–thallic complex compounds being formed.

T. H. P.

Mercuric Azide. A. Stettbacher (*Zeitsch. ges. Schiess. u. Sprengstoffw.*, 1920, **15**, 211—212).—The extreme sensitiveness of mercuric azide, even under water, renders it unsuitable for practical purposes. With stringent precautions, it may be prepared on a laboratory scale as follows. A solution of 6·5 grams of sodium azide is decomposed with concentrated sulphuric acid, and the gaseous hydrogen nitride produced is passed into 10 grams of mercuric oxide in 200 c.c. of boiling water. The hot solution of mercuric azide is passed through a filter in a funnel provided with a hot-water jacket, and the filtrate is gently agitated with a wooden splinter during cooling to avoid formation of crystals exceeding 1 mm. in length, these being extremely sensitive. A crystalline mass of mercuric azide is thus obtained of not appreciably greater sensitiveness than silver fulminate. An alternative method consists in mixing concentrated solutions of sodium azide and mercuric nitrate; mercuric azide is precipitated from this mixture as a powdery mass, which is even less sensitive than lead azide, but can be converted into the highly sensitive form by solution and crystallisation. Although mercuric azide has the same molecular weight, and develops the same volume of gas on detonation, as mercuric fulminate, its "brisance" is twenty to thirty times as great.

W. J. W.

A Revision of the Atomic Weight of Aluminium. The Analysis of Aluminium Bromide. Theodore W. Richards and Henry Krepelka (*J. Amer. Chem. Soc.*, 1920, **42**, 2221—2232).—Aluminium bromide was synthesised from very pure bromine and the purest obtainable aluminium. It was digested three times in nitrogen at different temperatures, and fractionated

by distillation twice in nitrogen and twice in a vacuum. The residue was in each case discarded, as were two of the portions first volatilised.

The aluminium bromide was decomposed by water in such a way that the reaction occurred slowly, and the solution precipitated by a weighed amount of pure silver. The silver bromide was collected and weighed.

The close agreement of all the five analyses shows that the material used was very nearly, if not quite, homogeneous. In the final four analyses, 15·84201 grams of aluminium bromide required 19·22350 grams of silver for complete reaction, corresponding with an atomic weight for aluminium of 26·963 (Ag = 107·88; Br = 79·916). This agrees fairly well with Thomsen's value, 26·99, and modern evidence seems to show that the atomic weight of aluminium is really less, not more, than 27. The new value is distinctly nearer a whole number than the old one. J. R. P.

Swelling Phenomena with Fibrous Alumina. HEINZ VON ZEHMEN (*Kolloid Zeitsch.*, 1920, **27**, 233—235).—Fibrous alumina as prepared by Wislicenus (*Zeitsch. angew. Chem.*, 1914, **17**, 803) constitutes a reversible gel. On heating, the loss of water takes place stepwise between 100° and 200°, inasmuch as a definite percentage of water is lost at any given temperature; 6·5% is lost at 100°, a further 3% at 150°, and 2—3% at 200°; above 200° there is no further loss. On keeping in an open dish, practically the whole of the water is readsorbed in one day, and the small residue in four to five days. The maximum adsorption of water is 60%, and this amount is taken up in a few weeks by keeping the fibrous material in an atmosphere saturated with water vapour. In taking up water, swelling occurs; thus 1·97 grams of material dried at 200° had a volume of 5·60 c.c., and on keeping for three days in an atmosphere saturated with water vapour, it increased in weight to 3·12 grams and in volume to 6·30 c.c. The power of adsorption of Congo-red has been examined. It is found that the air-dried material containing 13% of water adsorbs relatively more Congo-red than the ignited material, whilst with the completely hydrated material the adsorption is still greater. The increased power of adsorption is attributed to the increase in the degree of dispersion of the adsorbent by swelling. J. F. S.

The Permeability of Glass to Iodine and Bromine Vapours. JAMES BRIERLEY FIRTH (T., 1920, **117**, 1602—1603).

Electrolytic Formation of the Alkali Salts of Ferrous and Ferric Oxides. G. GRUBE and H. GMELIN (*Zeitsch. Elektrochem.*, 1920, **26**, 459—471).—The electrolytic formation of sodium ferrite and sodium ferrate has been investigated. It is shown that when iron which has been rendered active by cathode treatment is anodically polarised by a low current density in a 40% solution of sodium hydroxide and in complete absence of air, it passes into solution in the bivalent condition as sodium ferrite, Na_2FeO_2. At

80°, with a current density of 0·166 amp./sq. dcm., 0·026 molecular solutions of this compound may be prepared. The anodic solution of iron in strong solutions of sodium hydroxide at high temperatures takes place in two stages; in the first stage, iron dissolves in the bivalent condition, whilst in the second stage it passes into solution in the sexavalent condition as ferrate, with simultaneous evolution of oxygen. Nowhere does iron pass into solution in the tervalent condition. The electrolytic formation of sodium ferrite can be brought about either by anodic oxidation of an alkaline solution of ferrous hydroxide or by the cathodic reduction of sodium ferrate. Both reactions take place on platinum electrodes. The equilibrium potential of iron against a sodium ferrite solution and that of platinum against mixtures of ferrite and ferrate have been measured, and from the results the concentration of the ferric ions in the latter solution and of the ferrous ions in the former solution have been calculated. The results show that a solution of ferrite is much more complex than an alkaline solution of ferrous hydroxide. The anodic solution of bivalent iron in 40% sodium hydroxide takes place at 80° at potentials ϵ_H −0·84 to −0·82 volt. At a slightly higher potential, ϵ_H −0·8 to −0·7, the oxidation process $2FeO_2'' + 2\oplus \rightleftharpoons Fe_2O_4''$ takes place. In 40% sodium hydroxide solution, the equilibrium potential of the process $Fe + 2\oplus \rightleftharpoons 2Fe^{\cdot\cdot}$ lies at ϵ_H −0·86 volt, whilst that of the process $Fe^{\cdot\cdot} + \oplus \rightleftharpoons Fe^{\cdot\cdot\cdot}$ lies at ϵ_H −0·69 volt, and that of the process $Fe^{\cdot\cdot\cdot} + 3\oplus \rightleftharpoons Fe^{\cdot\cdot\cdot\cdot\cdot\cdot}$ at ϵ_H +0·55 volt. Using the above values, the potential of the reactions $Fe + 3\oplus \rightleftharpoons Fe^{\cdot\cdot\cdot}$ and

$$Fe + 6\oplus \rightleftharpoons Fe^{\cdot\cdot\cdot\cdot\cdot\cdot}$$

have been calculated, and the values −0 80 and −0·13 volt respectively found. J. F. S.

Cause of the Instability of Nickel Steels; its Elimination. Ch. Éd. Guillaume (*Compt. rend.*, 1920, **171**, 1039—1041. Compare *ibid.*, 1899, **129**, 155).—From a study of the effect of the addition of manganese or chromium or carbon to nickel steels on the instability of such steels, it is shown that the cause of such instability is due to the presence of carbon, and the consequent formation of cementite, the slow transformation of which is capable of producing the phenomena observed. The stabilisation of nickel steels would thus be brought about by the absence of cementite. It is shown that the addition to nickel steels of metals, such as chromium, tungsten, or vanadium, which have an affinity for carbon greater than that of iron, in sufficient amount render such steels far more stable, but a very slight residue of cementite always remains. To arrive at complete stability, it seems necessary to add to the alloy an excess of the third metal. W. G.

Nickel Plating of Aluminium. A. Mazuir (*Ann. Chim. anal.*, 1920, [ii], **2**, 335—336).—Aluminium may be plated with a compact adherent coating of nickel by scouring it with milk of lime, and, after thorough washing, immersing it in an acid bath

of a metallic chloride, preferably manganese or ferric chloride. Finally, it is subjected to a current of 2·5 to 3 volts and 1 to 1·5 amp. per sq. dcm. in a solution of nickel sulphate, the anodes consisting of sheet nickel. [See, further, *J. Soc. Chem. Ind.*, 1921, 13A.] C. A. M.

The Constitution of the Paramolybdates. S. POSTERNAK (*Compt. rend.*, 1920, **171**, 1058—1060).—Ammonium paramolybdate can be obtained in a crystalline form in the anhydrous state, and to it the constitution

$$(NH_4O)_3MoO(O{\cdot}MoO_2)_5O{\cdot}MoO(ONH_4)_3$$

is assigned. In addition, two new ammonium heptamolybdates intermediate between the para- and meta-molybdates have been prepared. *Triammonium heptamolybdate*,

$$(NH_4O)_3MoO(O{\cdot}MoO_2)_5O{\cdot}MoO_2{\cdot}OH,$$

is obtained by boiling a solution of ammonium molybdate with molybdic oxide. *Ammonium heptamolybdate*,

$$NH_4O(OH)_2MoO(O{\cdot}MoO_2)_5O{\cdot}MoO_2{\cdot}OH,H_2O,$$

is the crystalline crust formed by warming an ordinary solution of ammonium molybdate on a water-bath. W. G.

Preparation of Anhydrous Tin Tetrachloride. H. J. TAVERNE (*Chem. Weekblad*, 1920, **17**, 610).—The method employed by Hensgen (A., 1891, 1160) for the preparation of antimony trichloride is applied to tin. Chlorine which has been dried by passing through sulphuric acid and calcium chloride in succession is passed over granulated tin, contained in a tube about 40 cm. in length and 2 cm. in diameter, which is supported in an inclined position in an elementary-analysis furnace. The tube is connected at its lower extremity with an adapter piece, which fits through a cork in the neck of a distillation flask, the arm of which is connected to a calcium chloride tube. The chloride trickles down the tube, and collects as a yellow fluid in the flask, whilst the impurities in the tin remain behind in the tube. The chloride is afterwards redistilled, with the usual precautions. S. I. L.

Mineralogical Chemistry.

Flagstaffite, a New Mineral. F. N. GUILD (*Amer. Min.*, 1920, 5, 169—172).—A colourless, transparent, crystalline material was found in the radial cracks of pine-tree logs which had been buried for at least 500 years near Flagstaff, in Arizona. Drusy cavities contain well-developed orthorhombic crystals of prismatic habit, $a:b:c=1{\cdot}2366:1:0{\cdot}5951$. The material sublimes at the m. p. 99—100·5° as needles; it is readily soluble in warm alcohol

or benzene, from which it is re-deposited as crystals identical in form with the original ones. D 1·092. Material for analysis was re-crystallised from alcohol, after dissolving away associated yellow resin with ether. The results, C 66·21, H 11·55, O 22·24, agree with the formula C_4H_8O. The molecular weight, determined by the boiling-point method in benzene, is 210, requiring the formula $C_{12}H_{24}O_3$. This compound is near to colophonin ($C_{10}H_{22}O_3$). In its mode of occurrence it resembles fichtelite, but this contains no oxygen. L. J. S.

Naumannite from Idaho. EARL V. SHANNON (*Amer. J. Sci.*, 1920, [iv], **50**, 390—391).- Grains and nodules, formerly supposed to be argentite, are found in abundance embedded in clay in the De Lamar mine, Silver City, Idaho. The material is bluish-grey with metallic lustre and faintly shining grey streak. It is very sectile and malleable; fracture hackly and irregular (no cleavage); H $2\frac{1}{2}$, D 6·527. Deducting clay and marcasite, analysis gave Ag 75·98, Se 22·92, S 1·10%. L. J. S.

Boulangerite, Bismutoplagionite, and Jamesonite. EARL V. SHANNON (*Proc. U.S. Nat. Museum*, 1920, **58**, 589—607).—Since the publication of his paper on mullanite (A., 1918, ii, 117), the author has become aware that the formula $5PbS,2Sb_2S_3$ was suggested for boulangerite by Sjögren in 1897, and he shows in detail that the old analyses of boulangerite can be adjusted to agree with this formula. The name mullanite is therefore withdrawn, and the materials previously described under this name are now re-described as boulangerite. The following new analyses of boulangerite also agree with the formula $5PbS,2Sb_2S_3$, and the materials have in common a brown tinge in their streak. I, fibrous, from the North Star mine, Wood River district, Idaho. II, fibrous, from the Independence mine in the same district. III, a soft mass of interlaced fibres from Peru. IV, massive and schistose, from Ober-Lahr, Germany. V, massive and schistose, from Przibram, Bohemia.

	Pb.	Ag.	Fe.	Sb.	As.		Insol.	Total.
I.	55·52	trace	0·43	23·63	1·06	19·36	*	100·00
II.	53·79	trace	0·41	23·83	0·12	18·11	3·58	99·84
III.	54·34	trace	0·47	25·33	—	18·51	0·36	99·01
IV.	54·44	trace	—	24·55	—	18·98	1·50	99·47
V.	55·08	—	trace	24·38	—	18·65	1·10	99·21
VI.	40·77	7·40	0·46	30·61	—	20·81	—	100·80†

10·86 insoluble deducted. † Also Cu 0·75.

The description of bismutoplagionite repeats that previously published (A., 1920, ii, 324), it being added that the mineral is probably orthorhombic. Analysis VI is of "silver jamesonite" from the Poorman mine, Silver City district, Idaho. The material is light grey, almost silver-white, with reddish-brown streak, and is massive and fine-grained with only a suggestion of fibrous texture; it, however, passes into needles. These needles are very brittle,

indicating the presence of a perfect basal cleavage. The analysis gives the plumosite formula $2(Pb,Ag_2)S,Sb_2S_3$, and the mineral might be described as an argentiferous plumosite; but since the fibres are brittle, the silver is regarded as replacing iron, and the formula is written as $7(P_{4/5}[Ag_2]_{1/5})S,3\frac{1}{2}Sb_2S_3$ (compare A., 1907, ii, 700).

Fuller details are given of the naumannite from Idaho (preceding abstract). L. J. S.

A Graphic Method for the Comparison of Minerals with Four Variable Components Forming Two Isomorphous Pairs. E. S. Simpson (*Min. Mag.*, 1920, **19**, 99—106).—In the spinel-chromite series, the two pairs are MgO,FeO and Al_2O_3,Cr_2O_3, and the general formula is $(Mg,Fe)O,(Al,Cr)_2O_3$. The relative molecular preponderance of the components of each pair, stated as a percentage of the maximum, is given by the formulæ $x=100(m-f)/(m+f)$ and $y=100(a-c)/(a+c)$, where m, f, a, c represent the number of molecules of MgO, FeO, Al_2O_3, and Cr_2O_3 respectively. The values of x and y, calculated from a number of published analyses and from two new analyses (I and II), are plotted on rectangular co-ordinates. The four corners of the main square are occupied by the pure compounds, MgO,Al_2O_3 (spinel), MgO,Cr_2O_3 (here named picrochromite), FeO,Al_2O_3 (hercynite), and FeO,Cr_2O_3 (chromite). Sub-species and varieties of intermediate composition are divided off in symmetrical areas within this square. Analyses I and II are of ceylonite from serpentine at Namban, Western Australia; it is black (tawny-olive in thin section) and dense with microgranular structure.

	MgO.	FeO.	MnO.	Fe_2O_3.	Al_2O_3.	Cr_2O_3.	Total.	Sp. gr.
I. ...	13·65	17·45	0·26	3·80	42·09	22·76	100·01	4·12
II.	14·10	17·77	0·28	3·21	40·35	22·60	100·38*	4·04

* Incl. SiO_2 1·51, H_2O 0·56, from about 4% of included serpentine.

L. J. S.

Chromohercynite, a New Spinellide, from Madagascar. A. Lacroix (*Bull. Soc. franç. Min.*, 1920, **43**, 69—70).—Granular masses with shining black, vitreous lustre, D 4·415, were found with blocks of magnetite and concretionary limonite in the red earth of the gneissic region between Farafagana and Vangaindrano. The following analysis by Raoult gives the ratios

$$Cr_2O_3,FeO : Al_2O_3,(Fe,Mn)O : Al_2O_3,MgO = 2:1:1.$$

Cr_2O_3.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	SiO_2.	H_2O.	Total.
38·64	27·12	0·61	27·00	1·10	5·33	0·28	0·25	100·33

The formula may be written $FeCr_2O_4,(Fe,Mg,Mn)Al_2O_4$, representing a isomorphous mixture of chromite and hercynite in equal molecular proportions. The mineral contains more chromium and less magnesium than picotite. L. J. S.

Paternoite, a New Mineral of the Saliferous Stratum of Monte Sambuco in the Calascibetta Region (Sicily). F. MILLOSEVICH (*Atti R. Accad. Lincei*, 1920, [v], **29**, ii, 286—289).—The rounded, white nodules previously described (A., 1920, ii, 626) have D 2·11, *n* 1·47—1·48, and consist of minute, lamellar crystals of either the trimetric or monoclinic system. The mean composition is:

B_2O_3.	MgO.	K_2O.	Na_2O.	Cl.	SO_3.	H_2O.	Total.
66·02	10·93	1·08	0·36	2·35	1·06	19·16	100·96

The mineral consists essentially of a hydrated magnesium tetraborate, $MgO,4B_2O_3,4H_2O$, which the author names *paternoite*, carnallite and blödite being present as admixtures. T. H. P.

Minerals of the Melanterite and Chalcanthite Groups: Hydrous Manganese and Cobalt Sulphates. ESPER S. LARSEN and M. L. GLENN (*Amer. J. Sci.*, 1920, [iv], **50**, 225—233).—Dumps of sulphide ores (pyrites, copper-pyrites, and blende) at the Good Hope and Vulcan mines, Gunnison Co., Colorado, contain in many of the interstices a pale greenish-blue, columnar mineral of the melanterite group. Analysis of this (by M. L. GLENN) gave the formula $RSO_4,7H_2O$, with Zn : Cu : Fe = 100 : 98 : 19.

CuO.	ZnO.	FeO.	SO_3.	H_2O.	Insol.	Total.	Sp. gr.
12·37	12·89	2·14	28·78	42·61	1·11	99·90	2·02

This is named zinc-copper melanterite. On exposure to dry air it loses water, and passes into the pale blue, crystalline pentahydrate, which is called zinc-copper chalcanthite. In the same way, other minerals and substances of the melanterite group pass over into the chalcanthite group. Optical data are given in detail.

Optical data are also given for the several crystalline hydrates of cobalt sulphate and manganese sulphate. Ordinary blue, glassy cobalt sulphate is the hexahydrate; it alters on exposure to the air to the pink pentahydrate, and finally, in part, to the monohydrate. A solution of cobalt sulphate at 23° under reduced pressure yields the heptahydrate, at 45° the hexahydrate, and on the steam-bath the monohydrate. The ordinary pink, glassy manganese sulphate is the tetrahydrate; it alters on exposure to the nearly white monohydrate. A solution of manganese sulphate at 23° under reduced pressure yields the pentahydrate, at 45° the tetrahydrate, and on the steam-bath the monohydrate. L. J. S.

Descloizite from Portugal. ALFREDO BENSAUDE (*Bull. Soc. Portugaise Sci. Nat.*, 1920, **8**, 154—156).—This occurs as a crust of small, brown crystals with wad on limestone in the zinc mine of Perguiça, at Sobral da Adiça. Analysis by C. LEPIERRE gave:

V_2O_5.	As_2O_5.	PbO.	ZnO.	CuO.	MnO.	FeO.	H_2O.	Total.	Sp. gr.
22·32	0·11	61·77	12·10	0·28	0·74	0·22	2·30	99·84	6·00

The manganese is present as wad. Phosphate and chloride are

absent. This is the first record of a vanadate from Portugal, apart from a very doubtful one of carnotite. L. J. S.

The Age of the Autunites of Portugal. A. MUGUET and J. SEROIN (*Compt. rend.*, 1920, **171**, 1005—1006).—From a determination of the ratio radium/uranium in samples of Portuguese autunite, taking the value of this ratio for primary minerals as $3{\cdot}40 \times 10^{-7}$, the authors calculate the age of the autunite deposits in Portugal as 1250—1900 years. W. G.

Analytical Chemistry.

The Importance of Adsorption in Analytical Chemistry. I. M. KOLTHOFF (*Pharm. Weekblad*, 1920, **57**, 1510—1529).—See this vol., ii, 19.

A New Indicator Reagent for Acids and Alkalis. E. BABE and T. CABRERA (*Revista de agr., commercio y trabajo, Havana*, 1919, 537—539).—For the detection of the adulteration of milk by the addition of lye from wood ashes, a new indicator for acids and alkalis was found in the dried, blue blossoms of the butterfly pea (*Clitoria ternatea*, Linn.). Alcohol (90%) was the best solvent, although water may be used. In acid solution, the colour is a bluish-red, in neutral solution marine-blue, and in alkaline solution sky-blue. To show alkalinity in milk, the new indicator was found to be far more sensitive than phenolphthalein. It is also recommended for Kjeldahl and phosphoric acid titrations. It is interesting to note that in Cuba cases have been found where milk was diluted with lye of the same density (1·15), so that density measurements and the Babcock test would not disclose the adulteration. CHEMICAL ABSTRACTS.

Indication of the Acid and Basic Functions and their Estimation. I. M. KOLTHOFF (*Rec. trav. chim.*, 1920, **39**, 672—676).—To demonstrate the acid or basic function of a substance, even if the dissociation constant is very small, the method of indicators may be used, and at the same time the dissociation constant of the substance can be determined. The conductivity-titration method (compare A., 1920, ii, 49, 420, 421) is recommended for the estimation. W. G.

The Salt Error of Cresol-red. ROGER C. WELLS (*J. Amer. Chem. Soc.*, 1920, **42**, 2160—2167).—In the determination of the hydrogen-ion concentration of salt water by a colorimetric method with cresol-red as indicator, it is necessary to make a correction

for the effect of the salt on the colour of the indicator. This correction has been determined with buffer solutions of borax and boric acid, without and with sodium chloride, and a table of corrections for use with the indicator is given. J. R. P.

The Estimation of the Hydrogen-ion Concentration by means of Indicators. L. MICHAELIS and A. GYEMANT (*Biochem. Zeitsch.*, 1920, **109**, 165—210).—On adding a solution of a certain hydrogen-ion concentration to a one-colour indicator, a coloration of a definite depth is obtained. By estimating colorimetrically the depth of the colour produced, it is possible to determine the hydrogen-ion concentration. The best conditions under which these estimations can be carried out are described, and the formula for calculating the results is given. S. S. Z.

A New Nephelometer and the Principles of Nephelometric Measurements. HANS KLEINMANN (*Kolloid Zeitsch.*, 1920, **27**, 236—241).—A new nephelometer is described, which depends on the measurement of the height of a Tyndall cone in two liquids, one of which is a standard, which produces the same intensity of illumination in a telescope. The apparatus consists of two glass tubes, each graduated to a suitable volume and containing the liquid for comparison; these tubes are placed side by side on a metal table before two shutters, which may be opened to any measured amount. Into the glass tubes two cylinders of polished glass just dip, and the light passing through these from the Tyndall cones illuminates the two halves of an optical system. The width of the shutter opening is then regulated until the two halves of the field are equally illuminated. The height of the Tyndall cone is controlled by the width of the opening of the shutters, and the intensity of illumination varies directly with concentration. Experiments with the instrument show that there is a strict proportionality between turbidity and concentration in the two tubes for the ratio 1:4 between the concentrations in the two tubes. The instrument is easy to work, and amounts of phosphoric acid (P_2O_5) down to 0·0005 mg. in 25 c.c. of solution may be estimated, using the strychnine–molybdic reagent, with an average error of 0·5%. The essential point which must be insured in all experiments is that the size of the particles in the turbid liquid is uniform. J. F. S.

Turbidity Standard of Water Analysis. P. V. WELLS (*Bureau of Standards, Sci. Paper* No. 367, 1920).—The usual standard employed is a water containing 100 parts per million of silica in such a state of fineness that a bright platinum wire 1 mm. in diameter is just visible when immersed at a depth of 100 mm. in the water. The standard is, however, untrustworthy, the variations from the average amounting in some cases to more than 50%. If the standard was prepared and distributed by some central authority, the error would be eliminated to a considerable extent, and it is not impossible that standard samples of dry, powdered

silica can be prepared sufficiently uniform in size of particle to be used directly. W. P. S.

The Titration of Potassium Iodide with Mercuric Chloride. I. M. Kolthoff (*Pharm. Weekblad*, 1920, **57**, 836—842).—This method is employed for the analysis, amongst others, of Sirupus Iodeti ferrosi. The end-point is affected by the concentrations of the reagents, and corrections must be applied to obtain trustworthy results. The correction may be calculated without difficulty by applying the laws of mass action, since the complex salt, potassium mercuri-iodide, gives by dissociation mercuric iodide, which begins to separate as soon as its concentration is sufficient to give a saturated solution. By reason of this dissociation, mercuric iodide begins to separate before the equivalent amount of mercuric chloride has been added. By employing the value used by Auerbach and Plüddemann for the complex constant K, which governs the balanced action $HgI_4'' \rightleftharpoons HgI_2 + 2I'$, and the figure given by Morse for the solubility of mercuric iodide, a series of corrections may be calculated for any given concentration of the reagent solutions, and these are found to agree very closely with the figures determined by a series of titrations with known solutions.

The influence of temperature is found to be negligible, and foreign substances generally interfere but little, unless they enter into the formation of complex mercury salts. Thus sugar, alcohol, and sulphuric acid exercise no other effect than is naturally due to their presence as inert substances, whilst hydrochloric acid, and especially bromides and thiocyanates, exercise a very marked influence. S. I. L.

Microchemical Reactions of Iodic Acid. A. Bolland (*Compt. rend.*, 1920, **171**, 955—957).—A description is given of the appearance under the microscope of precipitates given by iodic acid with the following reagents: thallium nitrate, silver nitrate, barium chloride, strontium and calcium acetates, rubidium chloride, cæsium sulphate, rubidium cadmium chloride, potassium chloride, sodium acetate, ammonia, and manganous chloride. The first two reagents may be used to detect iodic acid at a dilution of 1 in 5000, the next one at a dilution of 1 in 2500, the next three at a dilution of 1 in 300, whilst with the remainder the dilution must not be more than 1 in 80, and preferably 1 in 20. W. G.

Gravimetric Analysis. XIV. Estimation of Sulphuric Acid in the Presence of Calcium, Phosphoric Acid, and Chromium. L. W. Winkler (*Zeitsch. angew. Chem.*, 1920, **33**, 287—288).—The results obtained in the estimation of sulphuric acid as barium sulphate are somewhat too low in the presence of calcium, owing to the precipitation of calcium sulphate. This error may be largely eliminated by dissolving the sulphate in 25 c.c. of 10% hydrochloric acid containing 0·5 gram of ammonium chloride, and adding 5 c.c. of 10% barium chloride, drop by drop,

to the boiling solution. The liquid is then diluted, again boiled, and left until next day before filtration. In the presence of phosphoric acid, some barium phosphate is precipitated. The method described above should be used, and a reduction of 1·1 mg. made from the dried precipitate or added to the ignited precipitate. Complete precipitation of sulphuric acid in the presence of chromium is effected by evaporating the filtrate and washings from the barium sulphate, dissolving the residue in 20 c.c. of hot water containing one or two drops of hydrochloric acid, separating the insoluble sulphate, and adding its weight to that of the original precipitate. C. A. M.

New Titrimetric Estimation of Hyposulphite. R. FORMHALS (*Chem. Zeit.*, 1920, **44**, 869).—The reduction of ferricyanide by hyposulphite is expressed by the equation $2K_3Fe(CN)_6 + Na_2S_2O_4 + 2H_2O = 2K_3NaFe(CN)_6 + 2H_2SO_3$, and the reaction can be utilised for the titrimetric estimation of the latter substance. About 0·5 gram of hyposulphite is dissolved in 50 c.c. of air-free water, and the solution is titrated with $N/10$-ferricyanide solution, with the addition of a few drops of ferrous ammonium sulphate solution as indicator, the end-point being determined by the formation of a permanent blue coloration of Turnbull's blue. The ferricyanide solution is preferably standardised by a preliminary titration with pure hyposulphite. G. F. M.

A Modification and Simplification of Kjeldahl's Method of Nitrogen Estimation. H. CITRON (*Deutsch. med. Woch.*, **46**, 655—656; from *Chem. Zentr.*, 1920, iv, 456).—A "Kjeldahl pear" is described by means of which the ammonia of the oxidised substance can be distilled and received automatically by placing the apparatus which contains it in a drying oven at 175°. S. S. Z.

The Comparative Estimation of the Total Nitrogen in Urine by the Methods of Dumas and Kjeldahl. W. MESTREZAT and (MLLE) MARTHE PAUL-JANET (*Compt. rend.*, 1920, **171**, 1019—1021).—Estimations of total nitrogen in the same samples of urine by Dumas's method and Kjeldahl's method indicate that there may be nitrogenous substances present in urine which are not estimated by Kjeldahl's method. Under certain conditions of medical treatment, the difference between the results obtained by the two methods may be as much as 10% of the actual value. W. G.

Estimation of Nitrogen in Nitrates and Nitrites by means of Copper-Magnesium Alloy. TH. ARND (*Zeitsch. angew. Chem.*, 1920, **33**, 296—298).—In order to prevent interference by other salts, the quantities of magnesium chloride solution and of copper-magnesium alloy prescribed in the method proposed previously by the author (A., 1917, ii, 504) should be increased to 50 c.c. and 5 grams, respectively. W. P. S.

The Estimation of Nitrites and Nitrates in Plant Tissue. W. H. Strowd (*Soil Sci.*, 1920, **10**, 333—342).—The plant tissue is extracted with cold water, and in one portion of the extract the total nitrogen present as nitrite and nitrate is estimated as ammonia after reduction with Devarda's alloy. Another portion of the extract is heated on a water-bath with an excess of aspartic acid for one hour, the nitrite thus being destroyed. The residual nitrate nitrogen is reduced with Devarda's alloy and estimated as ammonia. W. G.

The Estimation of very small Quantities of Arsenic in Urine, Blood, and other Body Fluids, and the Arsenic Balance in the Silver Salvarsan Treatment. Hugo Engelson (*Zeitsch. physiol. Chem.*, 1920, **111**, 201—222).—The principle of the method is based on the Ramberg-Sjöström method. The organic substance is decomposed by boiling with concentrated sulphuric acid and fuming nitric acid, and the residual nitrogenous compounds are removed by heating with ammonium oxalate. After adding water, hydrochloric acid, potassium bromide, and hydrazine sulphate, the arsenic is distilled over as the trichloride, which is received in water and titrated with potassium bromate. By employing this method, it was found that the best part of the arsenic of silver salvarsan injected in a patient remained in the body after sixteen days; only 26·6% of the total arsenic was recovered in the urine. S. S. Z.

Relation between certain Constants in the System CO_2 aq. -$CaCO_3$. A. Massink (*Pharm. Weekblad*, 1920, **57**, 862—866).—Values for the concentration of hydrogen ions in the system CO_2 aq.-$CaCO_3$ in equilibrium for various concentrations of HCO_3' are determined by two methods, the first using Tillman's formula, and the second a formula obtained on the lines followed by Kolthoff (*ibid.*, 1917, **54**, 986). Inaccuracies in working out his formula are ascribed to the latter, and a new equation, $[H^+]=2·29\times10^{-3}[HCO_3]^2$, is arrived at by correcting these. The new formulæ give very concordant results, with a small constant difference. S. I. L.

The Calculation and Estimation of Active Carbonic Acid in Drinking Water. I. M. Kolthoff (*Chem. Weekblad*, 1920, **17**, 390—396).—Massink's criticism (preceding abstract) has led to a further re-examination of the whole subject. The known determinations of $l CaCO_3$ are reviewed, together with the figures given by various authors for the solubility of the different forms of calcium carbonate in water, with and without the presence of carbon dioxide. From the results, assuming dissolved calcium carbonate to be completely dissociated, and dealing only with the hydrolysis of carbonate to hydrogen carbonate, the values $[OH']=7·7\times10^{-6}$ and $P_{OH}=5·11$ are determined at 16°. From this it follows that the dissolved carbonate is hydrolysed to the extent of 57%. A determination of P_{OH} in a solution of pure

carbonate confirmed the figure 5·11. No true figures can be obtained for the solubility of calcium carbonate at the boiling point, since carbon dioxide is evolved by decomposition of the hydrogen carbonate produced by hydrolysis, hydroxide being formed. A determination of the hydroxyl-ion concentration after boiling gave $7·7 \times 10^{-5}$, a value ten times greater than that found for the solution before boiling.

The table of Tillmans and Heublein for the solubility product of calcium carbonate in presence of free carbon dioxide is held to be inaccurate. From the author's expression for the concentration of carbon dioxide in mg. per litre, $\alpha^3(\text{combined } CO_2)^3 \times 3·44 \times 10^{-5}$, where α is the degree of dissociation of the calcium hydrogen carbonate, a new series of values is given, α being based on the conductivity measurements of Kendall.

A series of measurements of the solubilities of powdered marble in solutions containing various quantities of carbon dioxide was carried out, the solutions being prepared by shaking for several days at normal temperature; carbon dioxide was estimated in 100 c.c. after decantation by addition of ten drops of 1% phenolphthalein, and titration with *N*/10-sodium hydroxide until the rose coloration persisted for five minutes, whilst the hydrogen carbonate was determined in another 100 c.c. by titration with *N*/10-hydrochloric acid in presence of dimethyl-yellow. In the titration of the carbon dioxide, corrections must be introduced, since the amount of sodium hydroxide required in presence of phenolphthalein is found to be less than the amount equivalent to the carbon dioxide actually present; a table of the empirical corrections employed is given. The figures agree fairly well with the theoretical for values for combined carbon dioxide up to 100 mg. per litre; the experimental values are less than the calculated, and these, again, less than the values deduced from the table of Tillmans and Heublein. The table of these authors applies, in fact, only to systems in which the concentration of calcium is equal to that of hydrogen carbonate, which in practice is seldom the case in drinking-water, since this has usually some permanent hardness. A new table is accordingly given, the values for active carbon dioxide being directly determined by Heijer's method, and the figures deduced from the equation

$$[CO_2] = (\alpha^3[HCO_3]^2 \,.\, \tfrac{1}{2}[Ca^{\cdot\cdot}])/(1·13 \times 10^{-4}).$$

The table permits the calculation of the active CO_2 when the concentrations of HCO_3', CO_2, and $[Ca^{\cdot\cdot}]$ are known. S. I. L.

Perchloric Acid as a Dehydrating Agent in the Estimation of Silica. H. H. Willard and W. E. Cake (*J. Amer. Chem. Soc.*, 1920, **42**, 2208—2212).—The silica in metals and silicates can be rendered insoluble by boiling with concentrated perchloric acid solution (60 to 70%) for a short time. Less silica remains in the filtrate than by the usual method of evaporating the hydrochloric acid solution to dryness, and the process is far more rapid. The perchlorates formed are dissolved instantly on dilution with

water, leaving pure silica uncontaminated by sparingly soluble salts. J. R. P.

Volumetric Estimation of Potassium and its Application to the Analysis of Fertilisers. GUIDO AJON (*Giorn. Chim. Ind. Appl.*, 1920, **2**, 422—426).—This method consists essentially in precipitating the potassium as potassium hydrogen tartrate in presence of alcohol, washing the precipitate repeatedly by decantation with 96% alcohol, adding *N*/10-sodium hydroxide solution in 96% alcohol until the reaction is alkaline, dissolving the precipitate in aqueous *N*/10-sodium hydroxide solution, and determining the excess of the latter by titration. [See *J. Soc. Chem. Ind.*, 1921, 21A.] T. H. P.

The Composition of Potassium Platinichloride. A. VÜRTHEIM (*Chem. Weekblad*, 1920, **17**, 637—640).—In the estimation of potassium as platinichloride, it has been found that the composition of the salt does not correspond with that required by the formula K_2PtCl_6. In view of the various factors suggested by different workers on the subject, the matter has been re-examined.

For the preparation of the double salt, dilute solutions of the two pure salts were used, in order to avoid the difficulties introduced in drying by enclosed mother liquor, where the solutions are too strong. The solution was then evaporated at 90° until it became syrupy, the crystals being washed free from platinic chloride with 96% alcohol. Drying for two hours at 150° was found to give constant weights.

By using a constant quantity of the potassium chloride solution with a slight excess of platinum chloride, practically constant yields of the double salt were obtained. Platinum and chlorine were determined in each sample, the potassium being known from the quantity of potassium chloride solution taken. The mean of six concordant determinations gave K : Pt : Cl = 15·98 : 40·32 : 43·16, the formula K_2PtCl_6 requiring, using the latest atomic weights, 16·09 : 40·15 : 43·76.

Quantities of the double salt were recrystallised and dried under various conditions, and it was found that by precipitation from aqueous solution by means of alcohol, the salt was obtained absolutely free from water, drying at 110° being as effective as drying at 150° in arriving at constant weights. The compound so treated gave on analysis K : Pt : Cl = 16·09 : 40·63 : 43·51, which, although much nearer to the theoretical than the above results, still shows some deviation. The accuracy of the accepted atomic weight of platinum is questioned, and the variations in this constant, as accepted in the last twenty years, are pointed out. S. I. L.

Estimation of the Alkali Metals as Sulphates. N. SCHOORL and I. M. KOLTHOFF (*Chem. Weekblad*, 1920, **17**, 425—427).—Van Duin's conclusions (A., 1920, ii, 508), that in the conversion of pyrosulphate to normal sulphate by ignition with addition of

ammonium carbonate, errors are introduced, (*a*) by the presence of unburned carbon (especially in the case of alkali salts of organic acids), and (*b*) by the loss of alkali sulphate with the volatile ammonium salts in the ignition, are investigated, and shown to be inaccurate. All residual carbon is destroyed by *repeated heating with strong sulphuric acid in a closed crucible, care being taken not to evaporate off the acid too quickly.* If, after this, the colourless pyrosulphate residue be further strongly heated, it solidifies on the walls of the crucible, disengaging sulphur trioxide. If a fragment of ammonium carbonate is added while the crucible is kept at this temperature, it does not volatilise violently, but assumes a condition analogous to the spheroidal state, and disappears slowly and quietly. This course gives accurate résults.

The method suggested by van Duin, evaporating the pyrosulphate with ammonium carbonate solution and igniting the residue, is open to many objections; thus, alkali carbonates are formed in the solution, and the tendency to spitting is not diminished, but increased, because the crystals formed as the solution is evaporated enclose mother liquor. S. I. L.

Quantitative Analysis. XV. Estimation of Barium as Barium Sulphate. L. W. WINKLER (*Zeitsch. angew. Chem.*, 1920, **33**, 299).—To 200 c.c. of the neutral solution containing the barium salt are added 1 gram of ammonium chloride and 1 c.c. of $N/1$-hydrochloric acid, the mixture is boiled, and a slight excess of 5% ammonium sulphate solution is added. After eighteen hours, the precipitate is collected, washed, dried, and weighed. For a quantity of about 0·3 gram of barium sulphate, 1·6 mg. is deducted from the weight of the dry precipitate; if the precipitate is ignited before being weighed, 0·6 mg. is added to the weight found. W. P. S.

The Volumetric Estimation of Barium and Strontium as Chromates. I. M. KOLTHOFF (*Pharm. Weekblad*, 1920, **57**, 972—979).—The procedures given in the literature for the estimation of barium and strontium together, and in the presence of calcium, by the chromate method, and especially the work of van der Horn van den Bos (A., 1911, ii, 228), have been investigated with the view of obtaining accurate and trustworthy methods. In the absence of strontium, the presence of calcium having no effect on the estimation, barium may be determined by precipitation with excess of dichromate at the ordinary temperature in presence of a little acetate. After three hours, the precipitate is filtered off, and the excess of dichromate in the filtrate estimated iodometrically. If strontium is present, appreciable quantities will be thrown down with the barium by this method, but accurate results may be obtained by the following procedure. To 10 c.c. of the solution are added 10 c.c. of $4N$-acetic acid and 10 c.c. of $2N$-sodium acetate, with 20 c.c. of water. Slight excess of dichromate is added, the whole made up to 100 c.c., and filtered

after three hours. Fifty c.c. of the filtrate are treated with iodide, and the iodine liberated determined with thiosulphate.

For the estimation of strontium, after addition of the dichromate, pure ammonia is added until the solution is just yellow, and the strontium chromate precipitated with absolute alcohol, the excess of chromate being determined in an aliquot part of the filtrate, as before. In the presence of barium, the results are always low. Although the barium may be quantitatively estimated first by precipitation, and estimation of the chromate in an aliquot part of the filtrate, addition of ammonia and alcohol to another part of the filtrate (the procedure which gives good results for strontium alone) seems not to precipitate the strontium completely, the results being about 2% too low. This is attributed to the large amounts of acetate required. The presence of calcium also makes the method inaccurate, more than 100 mg. per litre causing serious errors. S. I. L.

The Separation of Barium, Strontium, and Calcium by the Chromate Method. I. M. Kolthoff (*Pharm. Weekblad*, 1920, **57**, 1080—1084).—The three elements can be satisfactorily separated qualitatively by the chromate method by the following procedure. The group IV carbonate precipitate is dissolved in dilute acetic acid, and the solution boiled to remove carbon dioxide. Sodium acetate is then added until its molecular concentration is equal to that of the acid, and the barium precipitated with a slight excess of dichromate. After five minutes, the precipitate is filtered off, and the filtrate made faintly alkaline with ammonia. Addition of an equal volume of rectified spirit, with more chromate if necessary, throws down the strontium, which is filtered off after half an hour. Calcium is detected in the filtrate by means of ammonium oxalate.

The precipitate from the alcoholic solution must be tested to confirm strontium, since acidity of the original solution will prevent complete precipitation of the barium, the last traces coming out of solution when ammonia and spirit are added; also, if the ammonia contains carbonate, some calcium may be thrown down. The precipitate may be tested by the flame reaction or the spectroscope, or may be washed with 50% alcohol, dissolved in hydrochloric acid, and the strontium thrown down as sulphate. One mg. of strontium can be detected in presence of 100 mg. of barium and 100 mg. of calcium per litre. The procedure will also detect 1 mg. of barium in presence of 100 mg. each of strontium and calcium; it is so sensitive for calcium that 0·1 mg. per litre can be detected in presence of 100 mg. each of barium and strontium. S. I. L.

Estimation of Lead as Chromate. C. W. Simmons, J. R Gordon, and H. C. Boehmer (*Canad. Chem. J.*, 1920, **4**, 139).—The following procedure is recommended for the volumetric estimation of lead in ores. A suitable amount of the ore is dissolved in a mixture of hydrochloric and nitric acids, the solution evaporated

to a volume of 8 c.c., a slight excess of ammonia is added, and then an excess of acetic acid. If the solution is not clear, 3 grams of ammonium acetate may be introduced. Ten c.c. of 10% potassium chromate are then added, the mixture is kept warm for five minutes, and the precipitate collected. The precipitate is dissolved in a mixture of 25 c.c. of concentrated hydrochloric acid and 75 c.c. of water, the solution diluted to 200 c.c., slightly less than 1 gram of potassium iodide is added, and the liberated iodine is titrated slowly with thiosulphate solution. W. P. S.

Titration of Lead as Lead Chromate. I. M. Kolthoff (*Pharm. Weekblad*, 1920, **57**, 934—941).—The various methods of applying the volumetric chromate method to the estimation of lead have been examined, and the method involving the use of iodine and thiosulphate is found to give the best results. For rapid estimations of small quantities, it is simplest to estimate the chromate in the washed lead chromate precipitate by dissolving this in dilute hydrochloric acid, adding excess of potassium iodide, and titrating the liberated iodine with thiosulphate. The difficulty that lead chromate separates to a large extent in the colloidal form may be overcome by adding a few drops of a 5% aluminium chloride solution, and by heating and shaking after addition of the chromate solution. The precipitate is collected on a cotton-wool filter, washed until free from soluble chromate, and transferred again to the flask in which it was thrown down, since particles of the precipitate are found to adhere to the walls. With experience, a complete determination can be carried out in fifteen minutes, the method giving very satisfactory accuracy. Where very low concentrations and small quantities of lead have to be determined, it is advisable to allow the precipitate to remain overnight, the solubility of lead chromate being found to be negligible.

The method is very suitable for the estimation of lead sulphate, which may be dissolved in sodium acetate with addition of a little acetic acid, and the solution treated with chromate, as above.

For high concentrations of the lead salt (up to one-twentieth molar solutions), accurate results may be obtained by titrating the excess of chromate with iodine and thiosulphate. Since the chromic acid liberated in the reaction $PbAc_2 + K_2Cr_2O_7 = CrO_3 + 2KAc + PbCrO_4$ functions as a strong monobasic acid, the determination may also be carried out by measurement of the conductivity changes when the reaction liquid is titrated with sodium hydroxide. The conductivity falls rapidly until all the chromic acid has been converted into dichromate, after which it rises slowly as the chromate is formed. This modification can, naturally, only be used where the lead is in the form of a salt of a strong acid.

S. I. L.

The Separation of Mercury from other Elements by Distillation from Hydrochloric Acid Solution. Wilhelm Strecker and Karl Conradt (*Ber.*, 1920, **53**, [*B*], 2113—2127). —In a previous paper (A., 1920, ii, 51) on the separation of

antimony from tin by volatilising from a hydrochloric acid solution, it was observed that mercury is also partly volatilised under similar conditions. Experiments have now been made to determine the conditions under which mercuric chloride can be completely volatilised from solution. By leading a current of hydrochloric acid gas through an aqueous solution of mercuric chloride at 110°, only very small quantities of mercury distilled over. Better results were obtained by dissolving the mercuric chloride in concentrated sulphuric acid and dropping concentrated hydrochloric acid into the solution while a current of the gas was passed through at 170—180°. When, in place of the concentrated hydrochloric acid, a mixture of this with 10% of hydrobromic acid was dropped in, the whole of the mercuric chloride was distilled over in half an hour at 160—170°. By dropping in the aqueous acid during the distillation, the accumulation of the mercuric chloride on the walls of the distillation vessel was prevented, and consequently the distillation was accelerated. Phosphoric acid, it was found, could be used in place of sulphuric acid, and in this case no advantage was found when hydrobromic acid was used with the hydrochloric acid. It was subsequently found that the stream of hydrochloric acid gas could be dispensed with, and a current of air or nitrogen used instead. From phosphoric acid solution, the mercuric chloride could be completely distilled over in one hour at 150—160° by slowly dropping water into the solution. Mercuric bromide was found to be much less volatile than the chloride.

By the distillation process, mercury can be readily separated from many other elements, copper, cadmium, iron, and the other elements of the ammonium sulphide group, barium and other alkaline earth elements. In the case of lead, if sulphuric acid is used for the distillation, the lead sulphate may enclose some of the mercuric chloride, and it is better to use phosphoric acid. The separation from bismuth is not complete, as the chloride of this element is volatile to some extent. E. H. R.

Electro-analytical Practice. W. BÖTTGER (*Zeitsch. Elektrochem.*, 1920, **26**, 445—452).—The author has examined the causes of the low results obtained in the estimation of mercury by electrodeposition. It is shown that mercury is quantitatively deposited from mercurous nitrate solutions in the presence of nitric acid when a constant *E.M.F.* of 1·4—1·5 volts is employed. When mercuric nitrate is used, the solution should be acidified with 1 c.c. of nitric acid (D 1·4). The *E.M.F.* is so regulated that the current strength remains at 1 ampere. To ensure this, the electrolysis is commenced with an *E.M.F.* of 1·8 volts, which rises to 3·0 volts in about four minutes, and finally reaches 3·2—3·3 volts, at which value the electrolysis is completed. The conditions for electrolysis in the presence of potassium cyanide are also given. The reasons for the loss so very often experienced and the amount of the loss are discussed. It is shown that pure alcohol and pure ether may be used for drying the deposit if the electrode is only

exposed to the air for a short time (ten to fifteen minutes). Losses due to keeping in a desiccator are vanishingly small. Losses due to loosening of particles of mercury, and washing away when wet electrodes are dipped into alcohol, are very small and approximately constant. The losses, in the estimation of acid solutions of the nitrate, using an *E.M.F.* of 1·4 or 1·5 volts, or of chloride solution, to which 1 c.c. of nitric acid (D 1·4) has been added, with an *E.M.F.* of 1·8—3·3 volts, amount to 0·4 mg. when a silvered net electrode is used. Separation from a cyanide solution gives slightly larger losses, 0·6 mg. The cyanide method is doubtful only when a large amount of potassium cyanide is present and when large currents are used. J. F. S.

The Analysis of Mercuric Chloride. I. M. KOLTHOFF and J. KEIJZER (*Pharm. Weekblad*, 1920, **57**, 913—919).—The method of Rupp for the estimation of mercuric chloride by reduction with formalin in warm alkaline solution, and estimation of the mercury so formed by treatment with excess of iodine in acid solution and back titration of the excess with thiosulphate, is found to give variable results. The variations are traced to two causes. The reduction in alkaline solution by means of formalin is not complete, some calomel being formed. The second source of error arises from the fact that although neither formalin nor its common impurities react with iodine, after warming with sodium hydroxide and subsequent acidification, as in Rupp's method, formalin is found to combine slowly with iodine, probably on account of the polymerising effect of the alkali.

A more accurate form of the method is found to be the use of alkaline hydrogen peroxide for the reduction, with subsequent acidification with sulphuric acid, the estimation being completed as before. Since the reduction requires fifteen minutes on the water-bath, with constant shaking, whilst it requires another thirty minutes to dissolve the separated mercury in iodine, the method is somewhat laborious.

A more satisfactory method is suggested on the basis of the work of Andrews (A., 1903, ii, 695), who found that the addition of pure hydrocyanic acid to a solution of mercuric chloride gave a strongly acid solution, on account of the very slight dissociation of mercuric cyanide. To the neutral mercuric chloride solution is added a slight excess of hydrocyanic acid solution (prepared from potassium cyanide and hydrochloric acid), which reacts neutral to dimethyl-yellow. The mixture is then titrated directly with sodium hydroxide, using the same indicator. The method gives very good results in all concentrations, but care must be taken that the solutions are neutral, and the hydrocyanic acid must be free from cyanic acid, which, being a relatively strong acid, introduces errors. S. I. L.

Analysis of Gold. H. WOLFF and N. SINGALOWSKY (*Zeitsch. angew. Chem.*, 1920, **33**, 298).—A criticism of a method described recently by Drawe (A., 1920, ii, 775). Older and better known

methods yield trustworthy results for the separation of silver and copper from gold; in Drawe's method there is the risk that silver and copper are not removed completely by a single precipitation.

W. P. S.

Estimation of the Phenolic Substances in Urine. FREDERICK F. TISDALL (*J. Biol. Chem.*, 1920, **44**, 409—427).—The values obtained by the method of Folin and Denis for the estimation of phenolic substances in urine (A., 1915, ii, 802) are as much as 50% higher than those which are obtained with the ether extraction method outlined in this paper. This suggests that there are unidentified substances present in urine which react with the colour reagents used by Folin and his collaborators, and are responsible for the high values obtained by the former method.

These unidentified interfering substances are partly present in the urine in the free state and partly formed by the action of strong mineral acids on the urine. Only a small fraction of the volatile phenols is excreted in the urine in the free state.

J. C. D.

Micro-estimation of Dextrose by Bang's Method. ALBRECHT MERTZ (*Zeitsch. physiol. Chem.*, 1920, **111**, 43—48).—By employing Bang's improved micro-method for the estimation of dextrose, a uniform reduction factor was obtained with quantities of 0·06—0·4 mg. of dextrose. The iodate solution employed in the estimation is stable if pure reagents are employed.

S. S. Z.

Estimation of Dextrose and Starch by the Alkaline Permanganate Method. FRANCISCO A. QUISUMBING (*Philippine J. Sci.*, 1920, **16**, 581—601).—The author has studied the influence of the concentration of the reacting substances, and the conditions of heating, on the oxidation of dextrose by potassium permanganate in presence of sodium carbonate. A method of procedure is described which can be applied to the estimation of dextrose; the excess of permanganate is determined by means of standard oxalic acid solution, and from the volume of permanganate reduced the amount of dextrose present is found by reference to a table. The method can be used for the estimation of starch in commercial starch after hydrolysis by acid or diastase, or in flours after hydrolysis by saliva or diastase but not after hydrolysis by acid.

J. H. L.

The Double-polarisation Method for the Estimation of Sucrose and the Evaluation of the Clerget Divisor. RICHARD F. JACKSON and CLARA L. GILLIS (*Bureau of Standards, Sci. Paper* No. 375, 1920).—The velocity of inversion of sucrose between 20° and 90° follows the exponential law first proposed by Arrhenius. From the rate of decomposition of invert-sugar in the presence of hydrochloric acid at different temperatures, it is

concluded that, for the Clerget method, 50° is the most satisfactory temperature. The value of the rotation, multiplied by 2, of 13 grams of sucrose in 100 c.c., inverted and polarised in the presence of 6·34*N*-hydrochloric acid, is $-33 \cdot 25°$ at 20°, and not $-32 \cdot 66°$, as given by Herzfeld; the basic value of the Clerget divisor is 143·25, and not 142·66. The presence of hydrochloric acid increases the lævorotation of invert-sugar; if C is the number of c.c. of 6·34*N*-hydrochloric acid per 100 c.c., the rotation, R, of invert-sugar is $R_T^{20} = -32 \cdot 00 - 0 \cdot 125C$. The effect of hydrochloric acid can be duplicated by normal salts, such as sodium chloride, potassium oxalate, and calcium chloride, and it is proposed to add 2·315 grams of sodium chloride to the solution for direct polarisation to secure a constant rotation of invert-sugar when it exists as an impurity. Four methods of analytical procedure are given, and the values of the Clerget divisor are tabulated in convenient form. W. P. S.

Technique of the Estimation of Lactic Acid and the Determination of the Maximum Capacity of Lactic Acid Formation of the Muscle. GENIA RIESENFELD (*Biochem. Zeitsch.*, 1920, **109**, 249—270).—The extraction of lactic acid with amyl alcohol according to Ohlson's method yields satisfactory results when aqueous solutions are employed, but not when the solutions contain protein. In the case of muscle extracts, the author therefore recommends the precipitation of the protein with phosphotungstic acid. When the solutions are boiled, a small and negligible quantity of the lactic acid is retained by the coagulum. In order to estimate the maximum lactic acid formation in muscle, the author recommends autolysing the minced organs under an antiseptic for three days, in order that the lactacidogen may pass into lactic acid. The presence of the lactic acid anhydride must be taken into consideration. S. S. Z.

Naphthalenesulphonic Acids. II. Detection of certain Naphthalenesulphonic Acids. JOSEPH A. AMBLER and EDGAR T. WHERRY (*J. Ind. Eng. Chem.*, 1920, **12**, 1085—1087).—The characteristics of the ferrous and naphthylamine salts of certain naphthalenesulphonic acids (this vol., i, 21) may be used for the detection of those acids in the mixed products of the sulphonation of naphthalene. The sulphonic acids are converted into sodium salts, and the solution tested with ferrous chloride, a precipitate indicating the 2-sulphonic acid. The boiling filtrate, treated with α-naphthylamine hydrochloride, will give a precipitate in the presence of the 1:5-disulphonic acid, whilst the 2:6-disulphonic acid may be detected in the filtrate from this by means of β-naphthylamine hydrochloride. The salts separated from the filtrate from the 2:6-disulphonate are extracted with acetone to separate β-naphthylamine naphthalene-α-sulphonate, whilst the 2:7- and 1:6-disulphonates are identified by their optical behaviour. [See also *J. Soc. Chem. Ind.*, 1920, 815A.] C. A. M.

The Quantitative Estimation of Acetone and Acetaldehyde in the same Solution. WILHELM STEPP and WILHELM ENGELHARDT (*Biochem. Zeitsch.*, 1920, **111**, 8—17).—Ripper's method for the estimation of acetone and acetaldehyde in mixtures (A., 1907, ii, 205) was found to be suitable provided that at least forty hours are allowed for the reaction to take place. Results obtained in the estimation of acetone and acetaldehyde in mixtures with the iodoform method were unsatisfactory. S. S. Z.

Reaction of "Saccharin." L. THEVENON (*J. Pharm. Chim.*, 1920, [vii], **22**, 421—422).—A bright red coloration is obtained when 0·1 gram of "saccharin" dissolved in 25 c.c. of water is treated with 10 c.c. of 0·1% sodium nitrite solution, 6 drops of dilute sulphuric acid, and, after a few minutes, 0·1 gram of β-naphthol. W. P. S.

Detection of very small Quantities of Indican (Potassium Indoxyl Sulphate) in Water as an Aid to Hygienic Water Analysis. ADOLF JOLLES (*Ber. Deut. Pharm. Ges.*, 1920, **30**, 421—442).—The presence of the merest traces of indican in a water is a certain indication of previous contamination with animal excretions, and as its detection by chemical means is very simple and not interfered with by the commonly occurring constituents of natural waters excepting nitrites, which, however, are readily eliminated by means of ferrous salts, its presence or absence forms an excellent criterion for the judgment of a water from the hygienic point of view. The test is performed as follows: 3 to 4 litres of the water are evaporated to 250 c.c., and if nitrites are present 3 grams of ferrous ammonium sulphate are added for every 0·1 gram of nitrite per litre of the original water. The evaporation is then continued to 10 c.c., and to the filtered solution 1 c.c. of 5% alcoholic thymol or α-naphthol solution and 10 c.c. of fuming hydrochloric acid containing 5 grams of ferric chloride per litre are added. After keeping for fifteen minutes with frequent shaking the indolignone colouring matter, which will have been formed if indican were originally present, is extracted by careful shaking with 4 c.c. of chloroform. A reddish- or bluish-violet coloration of the chloroformic layer, however slight, is a certain proof of the presence of indican, and of the previous contamination of the water with animal excreta. G. F. M.

Differentiation of the Extract of Yellow Wood (Morin) and the Extract of Quercitron (Quercitrin). ED. JUSTIN-MUELLER (*Bull. Soc. chim.*, 1920, [iv], **27**, 844—846).—The extract of these two woods may readily be distinguished from one another by dissolving a trace of extract, either dry or the concentrated solution, in sulphuric acid (D 1·817), and then diluting with water. Under these conditions, the extract of yellow wood remains bright orange-yellow, whilst the extract of quercitron is decolorised. A microscopic examination of the two extracts also serves as a means of differentiation. That of quercitron appears in more or less agglomerated granules, whilst that of yellow wood shows sharply defined crystals. W. G.

Apparatus for the Estimation of Small Quantities of Urea. A. J. L. Terwen (*Nederl. Tijdschr. Geneeskunde*, 1920, **64**, ii, 875—880; from *Chem. Zentr.*, 1920, iv, 638).—The estimation of urea by bromine and sodium hydroxide is liable to error, since ammonium salts, creatine, uric acid, and hydroxyproteic acids can also yield nitrogen under these conditions, whilst also about 7% of the nitrogen is converted into other compounds, and so escapes gas volumetric estimation. For many clinical purposes, however, relative values are sufficient. An apparatus is described which permits in three flasks the rapid consecutive performance of two parallel experiments, and a test with a known weight of urea. A U-shaped capillary gas burette is attached which permits the gas to be measured under atmospheric pressure. H. W.

The Catalytic Decomposition of an Alkaline Solution of Sodium Hypobromite by Copper Sulphate. Antagonistic Action of Iodine. P. Fleury (*Compt. rend.*, 1920, **171**, 957—960; *J. Pharm. Chim.*, 1920, [vii], **22**, 449—462).—The presence of copper as copper sulphate causes a steady decomposition of an alkaline solution of sodium hypobromite, thus interfering with the estimation of carbamide by this reagent. The decomposition increases rapidly with the concentration of the copper salt. Thus the presence of 1 part of copper as copper sulphate in 100,000 causes the decomposition of 42% of the hypobromite in twenty-four hours at 36—37°. The presence of 1 part in 1000 of potassium iodide or iodate completely inhibits this catalytic decomposition of the hypobromite solution.

W. G.

Urea and Nitrous Acid. H. Doublet and L. Lescoeur (*Compt. rend. Soc. Biol.*, 1920, **83**, 1103—1105; from *Chem. Zentr.*, 1920, iv, 520).—The authors employ the following reaction, $CO(NH_2)+2HNO_2=4N+CO_2+3H_2O$, for the estimation of urea in urine. Sodium nitrite, 69 grams to the litre, and normal nitric acid are employed. Just before use, 20 c.c. of each of the solutions are mixed. This is sufficient to decompose 600 mg. of urea. The evolved carbon dioxide is received in a special apparatus containing sodium carbonate, and the precipitated calcium carbonate is estimated titrimetrically. S. S. Z.

Estimation of the Azotæmic Index. M. Laudat (*Compt. rend. Soc. Biol.*, 1920, **83**, 1023—1025; from *Chem. Zentr.*, 1920, iv, 519).—A description of experiments in which pure urea and xanthylurea (m. p. 260—261°) were used in the control estimations of urea and total nitrogen. S. S. Z.

Method for the Estimation of Urea by Soja-bean. E. L. Kennaway (*Brit. J. Expt. Path.*, 1920, **1**, 135—141).—A technique for the estimation of urea is described by which 1 mg. can be estimated with an accuracy of 97%. The ammonia produced is not removed by an air current, and is titrated by means of a comparator. In the case of serum, an alcoholic extract is used without evaporation. Chemical Abstracts.

Microchemical Reaction of Morphine. KOLLER (*Zeitsch. Allg. Vest. Apothverein*, 1918, 332; from *J. Pharm. Chim.*, 1920, [vii], **22**, 442—443).—Characteristic crystals are obtained when a drop of dilute morphine solution is treated with a drop of slightly acidified Mayer's reagent. W. P. S.

Reaction of Sparteine. E. H. GRANT (*J. Amer. Pharm. Assoc.*, 1920, **9**, 704; from *J. Pharm. Chim.*, 1920, [vii], **22**, 441—442).—An aqueous solution of the alkaloid is rendered ammoniacal and extracted with chloroform; the chloroform solution is shaken with dilute sulphuric acid, the alkaloid again extracted with chloroform after the acid solution has been rendered ammoniacal, and the chloroform solution is evaporated. The residue is treated with bromine solution, evaporated to dryness, and the residue brought into contact with ammonia gas; a bright red coloration is obtained with as little as 0·0005 gram of sparteine. The residue must be removed from the source of heat immediately after the last trace of bromine solution has evaporated.

W. P. S.

Colorimetric Investigation of Tryptophan. II. Systematic Investigation of the Colorimetric Estimation of Tryptophan based on Voisinet's Reaction. The Application of this Method to Proteins and Organs. OTTO FÜRTH and FRITZ LIEBEN (*Biochem. Zeitsch.*, 1920, **109**, 124—152).—A suitable way of carrying out the estimation is as follows. To 2 c.c. of the solution a drop of 2% formaldehyde solution and about 15 c.c. of very concentrated hydrochloric acid are added; after about ten minutes, 10—12 drops of 0·05% sodium nitrite are also added, and the mixture made up to 20 c.c. with concentrated hydrochloric acid. After a short time, the violet coloration which is produced is compared with a standard tryptophan solution (0·1%). An error of about 10% was observed with this method. The estimation can also be carried out on insoluble and coagulated proteins without hydrolysis. The tryptophan content of a great number of proteins has been determined. S. S. Z.

Estimation of the Products of Degradation of the Protein Substances in Blood Serum. A. BACH and B. SBARSKY (*Compt. rend.*, 1920, **171**, 1175—1177. Compare A., 1916, i, 353, 682).—It has previously been shown that the reduction of nitrates by animal tissues is due to the combined action of a ferment and a co-ferment. Fresh milk contains the ferment, but not the co-ferment, but the latter is constituted by the products of degradation of proteins. For the estimation, 1 c.c. of serum, 0·2 gram of sodium nitrate, and 2 c.c. of fresh milk are incubated at 60° for half-an-hour. The liquid is then clarified by means of lead acetate, and in the filtrate the nitrite formed is estimated by the Hosvay-Lunge method.

The method has been applied to seven horses in the course of immunisation, and in every case it was found that the products of

degradation of proteins appeared in the serum on the day following the injection of the toxins, and then disappeared more or less rapidly. W. G.

The Estimation of Phosphatides. D. H. BRAUNS and JOHN A. MACLAUGHLIN (*J. Amer. Chem. Soc.*, 1920, **42**, 2238—2250).—The phosphatides are extracted from the material, previously dried, if necessary, with anhydrous sodium and calcium sulphates (compare Robertson, A., 1916, i, 350), with alcohol at 50—60°. The alcoholic extracts are evaporated to dryness and extracted with anhydrous ether The ethereal extract is evaporated to 30—40 c.c. and extracted with a saturated solution of sodium chloride, the ethereal layer being separated, the ether removed, and the residue dried and weighed. In this material the phosphorus is estimated colorimetrically, as described by van Eck (A., 1918, ii, 370). As a check, another portion of the extracted phosphatide may be hydrolysed by acid, and in the product the choline may be estimated as its platinichloride and the amino-nitrogen by Van Slyke's method. W. G.

Maltase. II. Estimation of Maltase in Yeast. RICHARD WILLSTÄTTER and WERNER STEIBELT (*Zeitsch. physiol. Chem.*, 1920, **111**, 157—179).—The fresh yeast is triturated with ethyl acetate until it liquefies, water is added, and the mixture is neutralised with ammonia. This yeast suspension is then made up to a definite volume with a known maltose solution and a buffer mixture; aliquot portions are withdrawn at two different intervals, the degree of hydrolysis estimated, and the "time value" calculated. The few experiments carried out by this method show that the most part of the maltase of the yeast is extracted in this way. This method is also suitable for the comparison of the hydrolyses of sucrose and maltose by a given yeast. S. S. Z.

A Test for Anti-Beri-beri Vitamin and its Practical Application. CASIMIR FUNK and HARRY E. DUBIN (*J. Biol. Chem.*, 1920, **44**, 487—498).—A yeast suspension is prepared by shaking a loopful of a forty-eight hours' pure culture of yeast in 100 c.c. of Nägeli solution on a shaking machine for three hours. Measured quantities of this suspension are then incubated for twenty hours at 30° in the presence of the unknown vitamin solution, control tubes with a vitamin solution of measured strength being employed. After incubation, the fermentation is stopped by heating the contents of the tubes at 75° for a few minutes, and the amount of yeast is estimated by centrifugalising in a specially calibrated tube. By this means, the authors believe they have obtained a valuable test for the presence of the vitamin-*B*, although the presence of inhibiting substances may interfere with the reaction in some cases. A number of substances were tested for the presence of the vitamin-*B* by this method. J. C. D.

General and Physical Chemistry.

Effects of Ring Closure on Spectrochemical Properties. II. Unsaturated Heterocyclic Compounds. K. von Auwers (*Annalen*, 1921, **422**, 133—159. Compare A., 1918, ii, 343).—The relations between unsaturated heterocyclic substances and the corresponding open-chain compounds are very involved; influences, the nature of which is still not fully understood, operate to mask regularities which undoubtedly exist. The author therefore refrains from dealing with the spectrochemistry of heterocyclic compounds in general, in the knowledge of which too many gaps still exist, and limits himself to a comparison of oxygen-containing heterocyclic compounds with corresponding unsaturated open-chain compounds, for example, α-pyrone and the ketone,

CHMe:CH·CH:CH·COMe,

2:6-dimethyl-γ-pyrone and phorone, coumarones and chromens and *o*-alkyloxystyrenes. The results show that there is as little fundamental difference between unsaturated *iso*- and hetero-cyclic compounds as between the corresponding saturated substances (*loc. cit.*). The production of a heterocyclic structure from an unsaturated open-chain compound causes, as a rule, a weakening of the exaltation, and, as in the case of saturated substances, the more so the more unsaturated is the chain. Alkyl or other substituents produce an effect opposed to that of ring closure.

The following substances are new: 1:2:4-*trimethylcoumarone*, $C_6H_3Me{<}\underset{O}{\overset{CMe}{\rule{2em}{0.4pt}}}{>}CMe$, colourless, highly refractive oil, b. p. 109·5—111°/10 mm., obtained in the usual manner from 1:4-dimethylcoumaranone and magnesium methyl iodide (2 mols.) in ethereal solution, has $D_4^{14\cdot0}$ 1·0267, D_4^{20} 1·021, n_α 1·54685, n_D 1·55332, n_β 1·56865, n_γ 1·58330 at 14·0°, n_D^{20} 1·5506; 1:4-*dimethyl-2-ethylcoumarone*, b. p. 124·7—124·8°/14 mm., has $D_4^{11\cdot4}$ 1·0108, D_4^{20} 1·003, n^α 1·54187, n_D 1·54715, n_β 1·56233, n_γ 1·57583 at 11·4°, n_D^{20} 1·5433.

C. S.

List of the most Sensitive Rays of the Elements, suitable for use in their Detection. A. de Gramont (*Compt. rend.*, 1920, **171**, 1106—1109).—The author has tabulated the most sensitive rays for eighty-three of the elements obtained in the condensed spark, with or without self-induction. The ultimate rays are indicated. The rays are tabulated as (*a*) observed by the eye, (*b*) observed by photography either with a crown uviol spectrograph or a quartz spectrograph.

W. G.

Molecular Phase Hypothesis, a Theory of Chemical Reactivity. E. C. C. Baly (*Engineering*, 1919, **108**, 574—575).—The new views advanced are an outcome of studies on light absorption, especially in the infra-red. Ordinarily, curves of absorptive power (plotted against frequency) rise to rounded-off

peaks, but when the substances are cooled in liquid air or hydrogen, the curves narrow down and are seen to consist of a series of secondary peaks culminating in the line of maximal absorptive power. This line marks the characteristic frequency, and there are constant frequency differences between the secondary peaks of a group. The frequencies of the bands or lines so resolved represent multiples of some fundamental frequency in the infra-red, and each element has one or several characteristic frequencies. When two elements combine, the characteristic frequency of the compound is the least common multiple of the frequencies of the constituents. This can be accounted for on the quantum theory. Energy is lost by the combination of *A* and *B*, and if *A* has the characteristic frequency 5, *B* the frequency 7, then the emission of energy (and also its absorption) will occur in energy quanta of $5 \times 7 = 35h$ (where *h* is Planck's constant). To understand the mechanism, the simple atom may be regarded as something resembling a Saturn system, a nucleus surrounded by a ring of electrons, the whole representing a field of magnetic force, the lines of force passing through the ring. In groups of atoms, the fields may be symmetrical or not; similar or opposite poles will face one another, and the resulting field of force may hence be closed or open; the lines of force may be imagined to be closed (on themselves) even in a single atom. The fields are opened up by chemical activation. Reactivity now depends on the disposition of the field; the closed system will not display reactivity, and the molecules of a system may be in different phases, which will account for the varieties of modifications in complex molecules, for example, of sulphur. Valency is a measure of the number of characteristic frequencies. The group properties of the alkali metals, catalytic action, and ionisation are referred to from the point of view of this theory. CHEMICAL ABSTRACTS.

Ultra-violet Absorption Spectrum of Benzene Vapour. KARL SCHULZ (*Zeitsch. wiss. Photochem.*, 1920, **20**, 1—35).—The ultra-violet absorption spectrum of benzene vapour has been measured, using a concave grating, 6·47 metres radius of curvature and ruled with 15,450 lines per inch. The iron arc was used as source of light, and the first-order spectrum was photographed. Seventy-five bands were measured with an accuracy of 0·01—0·1 Å.U. The values are tabulated and compared with those of Witte (A., 1915, ii, 500). The structure of the spectrum is considered, and it is shown that a difference of 92·1 exists between the members of the long series. J. F. S.

Inorganic Luminescence Phenomena. II. Luminescent Boron Nitride. (Balmain's Aethogen) and the Excitation of Luminescence by Flames. ERICH TIEDE and FRIEDRICH BÜSCHER (*Ber.*, 1920, **53**, [*B*], 2206—2214. Compare A., 1920, ii, 723).—Balmain discovered boron nitride in 1842, and reported that it glows with a green light when held in the edge of a flame, but, like Wöhler (1850), he ascribed the phenomenon to a slow

oxidation of the substance. Various preparations of boron nitride have now been obtained, and it is found that unless they contain free boric acid, they do not exhibit the phenomenon. The effect is best produced by heating with a hydrogen flame, but is quite as strong in a flame obtained by burning chlorine in hydrogen. The luminescence is therefore not due to oxidation, but is physical in origin. As far as can be proved by chemical means, no foreign metallic impurity is necessary, but inactive samples can be rendered thermoluminescent by fusing them with boric acid in a well-closed crucible. The colour of the light emitted changes from blue to pale green with rise of boric acid content, but when there is more than about 10% of boric acid present, the effect is no longer observed.

All the thermoluminescent specimens are also phosphorescent, the effect being observed after exposure to daylight, an arc light, mercury-vapour light, *X*-rays, radium rays, and especially cathode rays. Moreover, specimens which emit green light when heated give green light after exposure to cathode rays, and blue thermoluminescence is paralleled by blue phosphorescence. What is more, specimens which contain too much boric acid to respond to the heat effect, such as those which have been heated in the air, and so allowed to oxidise, are nevertheless strongly phosphorescent with sky-blue to cyan-bluo light. If such specimens, however, are heated sufficiently to melt the encrusting boric acid, the core suddenly exhibits its thermoluminescence. It appears that the small amount of boric acid necessary to cause the heat effect is intimately combined with the boron nitride.

Other thermoluminescent substances are lime containing a trace of bismuth or manganese (Donau, A., 1913, ii, 743; Paneth, A., 1919, ii, 67, 68), and phosphorescent zinc sulphide and silicate. In the case of zinc sulphide, the light emitted after exposure to daylight is yellow, but after heating with a hydrogen flame, green. The flame seems to be necessary to activate the preparation, for a specimen needs merely to be touched by the flame in order to make it glow subsequently on an electric hot-plate. Boron nitride placed in a carbon boat heated to redness by an electric current also glows so strongly where the carbon monoxide flame touches it that the blue light overshadows the red. What it is about the flame, whether ultra-violet radiations or emission of ions or electrons, that causes this activation is briefly discussed, but without any definite conclusions being reached. J. C. W.

Inorganic Luminescence Phenomena. III. Phosphorescence of Boric Acid. Erich Tiede (*Ber.*, 1920, **53**, [*B*], 2214—2216).—If boric acid is dehydrated either in the air or in a vacuum over phosphoric oxide, either slowly at 300° or quickly at red heat, it becomes phosphorescent, the phenomenon reaching a maximum with a certain, minute proportion of water still present, but disappearing as full dehydration is attained. The exceptionally bright light emitted does not continue for long, and

may be excited by an arc or mercury lamp, but not by cathode, X-, or radium rays, or by heat. J. C. W.

Photochemical Studies. XI. Photochemical Equilibria. JOH. PLOTNIKOW (*Zeitsch. wiss. Photochem.*, 1920, **20**, 93—122. Compare A., 1920, ii, 461).—A theoretical paper in which the theoretical considerations in connexion with the equilibria in photochemical processes are treated mathematically. J. F. S.

Photochemistry of Alkyl Iodides and Iodine Solutions. HANS STOBBE and PAUL SCHMITT (*Zeitsch. wiss. Photochem.*, 1920, **20**, 57—92).—Alkyl iodides, either pure or in solution in paraffins, light petroleum, benzene, toluene, chloroform, ethyl ether, carbon tetrachloride, phenetole, acetic esters, or nitrobenzene, do not become coloured when preserved in the dark for two and a-half months. But in daylight a coloration is produced in a few hours in all cases. The coloration does not occur if oxygen is absent. The action of ultra-violet light on solutions of ethyl iodide, in benzene or carbon tetrachloride at 46—48°, and also in ethyl alcohol, has been studied. Solutions (6·25N) of methyl iodide, *n*-propyl iodide, and *iso*propyl iodide in benzene and ethyl alcohol have also been studied. It was also found that a solution of iodine in benzene or chloroform, after illumination for twenty hours with a quartz mercury lamp, on dilution gave a yellow solution, and not a red solution, as untreated iodine solutions do. To explain this action, the absorption spectrum of iodine, in alcohol, aqueous alcohol, methyl alcohol, propyl alcohol, *iso*propyl alcohol, and *sec.*-butyl alcohol solutions has been measured. Measurements were also made with alcoholic solutions of iodine to which organic iodides, ether, anisole, phenetole, and dimethylpyrone had been added. The experiments show that the decomposition of alkyl iodides with the liberation of iodine is an oxidation. Ethyl, methyl, and *n*-propyl iodides are similar in their behaviour toward light, but *iso*propyl iodide is much less stable. Iodobenzene behaves similarly to the primary aliphatic iodides. Ethyl bromide is decomposed by ultra-violet light of short wave-length with the liberation of bromine. Solutions of iodine in alcohols pass, in the course of time, into solutions of periodides (hydrogen tri-iodide or other additive compounds); this reaction is accelerated by light or spongy platinum. The absorption spectrum of true solutions of iodine consists of a single absorption band in the visible part of the spectrum, the position of which is independent of the nature of the solvent. The more the absorption is displaced toward the violet end of the spectrum the greater is the heat of solution of iodine in the solvent. When such solutions are diluted with several volumes of benzene or chloroform, the colour immediately becomes red. The spectrum of the periodide solutions shows two absorption bands in the ultra-violet with frequencies 2800 and 3450, and on dilution with benzene or chloroform yellow solutions are obtained. During the change of iodine into the periodide, solutions of mixtures are formed which show three absorp-

tion bands. The spectra of iodine described by various observers indicate that from 5% to 100% of the iodine present had been converted into periodide. Dimethylpyrone iodide exhibits the same spectrum as the periodide. J. F. S.

Beta ray Emission from Thin Films of the Elements exposed to Röntgen Rays. LEWIS SIMONS (*Phil. Mag.*, 1921, [vi], **41**, 120—140).—Thin films of arsenic, selenium, zirconium, silver, tin, antimony, barium, gold, lead, and bismuth have been exposed to *X*-rays from a Coolidge tube with barium or silver secondary radiators and the radiation examined. It is shown that it is improbable that the maximum speed of ejection of electrons from different substances under the influence of *X*-rays of definite wavelength is exactly constant, independently of the nature of the substance, and dependent only on the frequency of the incident *X*-rays. The present experiments show that throughout the whole range of motion the distribution of electrons depends fundamentally on the substance from which they are emitted, but the difference, if any, in the maximum velocities is too small to be demonstrable by this method. The experimental results point to the conclusion that there may be speeds of emission of electrons from an atom *S* when *X*-rays of frequency v fall upon it, given by either $\frac{1}{2}mv^2 = hv - {}_S(hv_K + hv_L + hv_M + \ldots)$, each successive speed being given by the removal of a term from the bracket, commencing with the term $\frac{1}{2}mv^2 = hv - {}_S(hv)_{K \text{ or } L \text{ or } M}$, or the expression in brackets representing the potential energy of the electron from whichever atomic ring it was ejected, v_K, v_L, etc., being the *K*, *L*, etc., frequencies of the *X*-ray spectral lines of the parent atom, *S*. The experimental data agree rather better with the latter expression. There is a type of electronic emission fundamentally associated with each type of *X*-ray emission. Assuming that it is not a necessary condition that each of the radiating atoms of one substance should be emitting all possible types of spectral lines, from those of the highest energy downwards, then the energy of electronic emission of any one of these atoms is complementary to that of its wave-emission; in other words, the "*K*" electron is the slowest on emergence, the concomitant "*L*" electron faster, and so on. J. F. S.

Radiating Potentials of Nitrogen. H. D. SMITH (*Physical Rev.*, 1919, **14**, 409—426).—A formula is derived for the distribution of the velocities of the impact electrons which may be applied to the observed values for the radiating potentials. Measurements gave (*a*) a strongly marked value at 8·294±0·04 volts, (*b*) a doubtful one at 7·3 volts, and (*c*) at low pressures a strong one at 6·29 volts. These values correspond with (*a*) $\lambda = 1490{\cdot}7$, a doublet noted by Lyman; (*b*) $\lambda = 1700$, the nearest known line is a doublet at 1744, which is sometimes also attributed to silicon; (*c*) $\lambda = 1965$, similar to a band at 1870. Traces of nitric oxide may have affected the values a little. From (*a*) the upper limit of the heat of dissociation of the nitrogen molecule into atoms is 190,000 cal., and from (*b*)

the most probable value is 145,000 cal. Qualitative evidence is given supporting the ionising potential for nitrogen at 18 volts as obtained by Davis and Goucher. CHEMICAL ABSTRACTS.

The Question of the Existence of Isotopes with the same Atomic Weight. STEFAN MEYER (*Zeitsch. physikal. Chem.*, 1920, **95**, 407—433).—See A., 1919, ii, 384.

Dielectric Constant of Selenium Oxychloride. JAMES E. WILDISH (*J. Amer. Chem. Soc.*, 1920, **42**, 2607—2609).—The dielectric constant of selenium oxychloride (b. p. 179·4° at 745·44 mm.) has been determined at 0°, 10°, and 20° by the Schmidt modification of Drude's method. As a mean of experiments with three cells, liquid selenium oxychloride has a dielectric constant at 20°, 46·2 ± 1, and at 10°, 51·00 ± 0·5; solid selenium oxychloride has the constant 16·8 ± 2 at 0°. The dielectric constant has a temperature-coefficient of 1·04%. J. F. S.

The Variations with Temperature of the [Electrical] Conductivity of Calcium Sulphide. P. VAILLANT (*Compt. rend.*, 1920, **171**, 1380—1383).—When a thin layer of calcium sulphide, previously insulated, is heated its conductivity increases rapidly, the curve showing a very acute maximum, and then decreases practically to zero. The gradient conductivity-temperature is greater and the maximum higher when the heating is more rapid. This phenomenon is connected with the state of phosphorescence, as, if the specimen is allowed to cool before the conductivity has become zero and is then heated again, much smaller variations and maxima are obtained. The increase in temperature has two effects on the conductivity of the calcium sulphide varying its instantaneous value and increasing the amount of variation with duration of heating. The first effect, where duration of heating does not intervene is governed by the equation $c = 1{\cdot}17e^{0\cdot130T}$, where T is the temperature, and c is the conductivity. The variation of c with the time at different temperatures is, for each temperature observed, an exponential variation of the type $c = c_0e^{-bt}$, the coefficient b being itself a linear function of the temperature. W. G.

Conductivity Cell. FRANK E. RICE (*J. Ind. Eng. Chem.*, 1920, **12**, 1202).—A cell for use in measuring the conductivity of solutions consists of a glass tube about the size of an ordinary burette; two platinum wires are fused through the sides of the tube at some distance apart, and platinum bands are fitted round the tube and over the outer ends of the wires. The wires inside the tube are sufficiently long to reach to one end and outside the tube, and one inside tube is covered with narrow glass tubing for the purpose of insulation. The ends of the tube are closed with rubber stoppers and a thermometer passes through the stoppers and tube, the bulb of the thermometer extending just through one stopper, so that it

comes into contact with the liquid in which the tube is immersed during a test. W. P. S.

Ionisation of Aqueous Solutions of Ammonia in the Presence of Carbamide. WINTHROP M. BURKE (*J. Amer. Chem. Soc.*, 1920, **42**, 2500—2506).—The equivalent conductivity of ammonia at various concentrations in $2M$-carbamide solution has been determined at 25·00°±0·01° with the object of ascertaining whether the ionisation in this solvent, which has a greater dielectric constant than water, is greater than in pure water, as from analogy should be the case. The results show that the ionisation of ammonia in carbamide solution, as in pure aqueous solution, conforms with the law of mass action, but the ionisation constant is $12·92 \times 10^{-6}$ in carbamide solution as against $18·1 \times 10^{-6}$ in aqueous solution, thus presenting an exception to the Nernst-Thomson hypothesis. This difference (30%) cannot be due entirely, or to any large extent, to a change in viscosity, and it is possible that an ammonium–carbamide complex is formed which has a smaller ionisation constant than ammonium hydroxide. J. F. S.

Conductivity and Viscosity of Solutions in Dimethylamine, Trimethylamine, Ethylamine, Diethylamine, Triethylamine, and Propylamine. HOWARD MCKEE ELSEY (*J. Amer. Chem. Soc.*, 1920, **42**, 2454—2476).—The electrical conductivity and the viscosity of solutions of various concentrations of silver nitrate, silver iodide, barium thiocyanate, lithium chloride, ethylamine hydrochloride, and dimethylamine hydrochloride in the solvents named in the title have been determined at −33·5°. It is shown that dimethylamine is a poorer solvent than ethylamine, although the salts which did dissolve formed solutions which have about the same molecular conductivity. Diethylamine is a still poorer solvent and a distinctly poorer ionising solvent, a solution of lithium chloride in this solvent being no better a conductor than silver iodide in ethylamine. The tertiary amines are not good electrolytic solvents, no evidence of salt solution being found in any case, and the solvent in equilibrium with the solid solute did not gain appreciably in conductivity. The aminolysis of barium thiocyanate in solution in ethylamine has been followed by conductivity measurements for ninety-five hours. The specific conductivities of some of the solvents at −33·5° are recorded: trimethylamine, $2·2 \times 10^{-10}$; ethylamine. $4·6 \times 10^{-8}$; and diethylamine, $2·2 \times 10^{-9}$. The viscosities measured are: ammonia, $2·54 \times 10^{-3}$; ethylamine, $5·749 \times 10^{-3}$; dimethylamine, $4·368 \times 10^{-3}$; trimethylamine, $3·208 \times 10^{-3}$; diethylamine, $8·236 \times 10^{-3}$; and triethylamine, $7·726 \times 10^{-3}$, all at −33·5°. The following densities at −33·5° are also given: dimethylamine, 0·727; trimethylamine, 0·702; ethylamine, 0·742; diethylamine, 0·713; and triethylamine, 0·778. J. F. S.

Saturated Potassium Chloride Calomel Cell. HAROLD A. FALES and WILLIAM A. MUDGE (*J. Amer. Chem. Soc.*, 1920, **42**, 2434—2453).—The *E.M.F.* of the combination

$$Hg,HgCl \mid KCl(sat.) \| KCl(sat.) \mid 0·1N\text{-}HCl \mid H_2(Pt)$$

has been measured over the temperature range 5—60° at intervals of 5°. Taking the value of the normal calomel cell at 25° as 0·5648 volt, the value of the saturated potassium chloride calomel cell at 25° is 0·5266 volt. It has a temperature-coefficient of +0·00020 volt/degree over the range 5—60°. The *E.M.F.* of the system Hg,HgCl | x*N*-KCl‖(sat.)KCl‖0·1*N*-HCl | H_2(Pt), and the value of the electrode, Hg,HgCl | x*N*-KCl, in the above system at 25° have been calculated for values of x ranging from 0·1*N* to 4·12*N*. The *E.M.F.* of the combinations

Hg,HgCl | 0·1*N*-KCl‖(sat.)KCl‖KCl(sat.) | HgCl,Hg,
Hg,HgCl | 1·0*N*-KCl‖KCl(sat.)‖KCl(sat.) | HgCl,Hg,
Hg,HgCl | 0·1*N*-KCl‖(sat.)KCl‖1·0*N*-KCl | HgCl,Hg,
Hg,HgCl | 0·1*N*-KCl‖KCl(sat.)‖0·1*N*-HCl | H_2(Pt),

and Hg,HgCl | 1·0*N*-KCl‖(sat.)KCl‖0·1*N*-HCl | H_2(Pt) has been measured over the temperature range 25—40° at intervals of 5°, and it is found that these combinations are quite untrustworthy above 25°, and only trustworthy at 25° for about one week. It is shown that the decrease in the *E.M.F.* of 0·1*N*- and *N*-potassium chloride calomel cells, when used in conjunction with a saturated salt bridge, is due to the diffusion of the concentrated solution of potassium chloride from the bridge into the cell, and not to the formation of a complex ion as a result of the interaction of the calomel and the potassium chloride solution. In preparing new calomel cells, it is necessary to use all new materials, and not simply replace the potassium chloride solution. The saturated potassium chloride calomel cell is the best cell for use in conjunction with a saturated salt bridge, because it has a very small temperature-coefficient, is easily reproducible, can be safely used at all temperatures from 5° to 60°, and can be relied on for its constancy of *E.M.F.* over long periods of time. J. F. S.

Recovery of Transmissivity in Passive Iron Wires as a Model of Recovery Processes in Irritable Living Systems. I. Ralph S. Lillie (*J. Gen. Physiol.*, 1920, **3**, 107—128).—A paper in which certain processes occurring in the activation of passive iron wires are shown to be analogous to an irritable and conducting living element, such as a nerve fibre or muscle cell. When passive iron wire is dipped into nitric acid of a concentration above a certain critical concentration, the activation is only temporary, and is followed immediately by an automatic return of the metal to the passive condition. Activation initiated at any part of such a wire is thus transmitted rapidly along its whole length in a wave-like manner, each region as it becomes active activating the region adjoining, and immediately becoming passive again itself. In order to maintain activity in the living system, constant repetition of stimulation is necessary, and, similarly, chemical activity in a passive wire immersed in nitric acid (D 1·42) is an automatically self-limiting process, which can be maintained only by repeated contacts with the activating metal. After a wire

has been activated in the usual manner and has reverted to the passive state, it is found to be impossible to reactivate it until a definite interval of time has elapsed. This failure to reactivate the wire is comparable with the similarly inexcitable and non-conductive interval, or "refractory period," of irritable living systems. J. F. S.

The Crystallisation of Metals by Electrical Precipitation and certain Connected Phenomena. A. H. W. ATEN and (MLLE). LOUISE M. BOERLAGE (*Rec. trav. chim.*, 1920, **39**, 720—735).—The electrical precipitation of metals may result in any of the following, namely, (1) isolated crystals; (2) continuous layer with markedly crystalline structure; (3) perfectly supple, continuous layer without visible crystalline structure; (4) elongated, needle-like crystals; (5) a black deposit. The conditions governing, more particularly, the first type of deposit have been studied in the case of the electrolytic deposition of silver from a solution of silver nitrate. The forms are regulated by the three factors: number of crystals, velocity of growth of these crystals, variation of the polarisation tension with the current density. It is shown that the number of crystals per sq. mm. is practically a linear function of the intensity of the current, except when the current density becomes too great, and the number is greater the more dilute is the silver nitrate solution. It is only in the case where the polarisation tension is small that isolated crystals can be formed. A high value of $\Delta e/\Delta i$ will give a homogeneous, supple deposit. The formation of a uniform deposit of a metal on an irregular object is regulated by the magnitude of the variation of the polarisation tension with the current density. The addition of potassium nitrate, nitric acid, or gelatin to the solution of silver nitrate very considerably increases the number of crystals formed on a given area of the cathode. W. G.

Measurement of Low Magnetic Susceptibility by an Instrument of New Type. ERNEST WILSON (*Proc. Roy. Soc.*, 1921, **98**, [*A*], 274—284).—An instrument is described whereby the susceptibility may be measured over a wide range of magnetic force. The instrument, which makes no use of a scale and spot of light, is of a portable type. The force due to torsion in the Curie instrument is replaced by either an electromagnetic or an electrostatic system, in which the mechanical force is due to two components, one proportional to the magnetic force impressed on the specimen, and the other also proportional to the magnetic force in the case of constant susceptibility, but variable if the susceptibility varies. In the electromagnetic case, which is the method described, a moving coil is used, which is suspended in a magnetic field proportional in strength to the magnetic force acting on the specimen. It has the advantage that the absolute value of the susceptibility can be calculated from the known details of the instrument, and a considerable mechanical force can be produced. A full description of the construction and the theory of the apparatus is given, and

measurements are recorded for manganese sulphate, chrome alum, iron pyrites, kenyte, franklinite, green serpentine, grey granite, copper pyrites, and ferrous oxide. The following values of K_m, the mass susceptibility, are given for various values of H, the magnetic force: manganese sulphate, K_m $94{\cdot}2 \times 10^{-6}$ (mean), H 25—642 c.g.s.; iron pyrites, K_m 0·99—$0{\cdot}979 \times 10^{-6}$, H 168—740 c.g.s.; chrome alum, K_m 13·7—$13{\cdot}0 \times 10^{-6}$, H 49—717 c.g.s.; kenyte, K_m 253—300×10^{-6} for H 26·5—134 c.g.s., with a maximum of 318×10^{-6} at 72·2 c.g.s.; copper pyrites, K_m 0·0102—0·0169, H 6·4—42·2 c.g.s.; and ferrous oxide, K_m 0·0128—0·0211, H 6·4—82·4 c.g.s. J. F. S.

Magnetism and Atomic Structure. I. A. E. Oxley (*Proc. Roy. Soc.*, 1921, **98**, [*A*], 264—274).—The close relationship which exists between the equilibrium positions of diamagnetic and paramagnetic crystalline substances suspended in a magnetic field, and the directions of the cleavage planes, can be satisfactorily interpreted in terms of a spacial distribution of electron orbits round the nucleus. The orbits may have any shape, but are probably small in comparison with atomic dimensions. In non-ionised media there is evidence that the coupling force between the units of the crystalline structure is that of magnetic induction, the mechanical stress accompanying it being balanced by the stress due to the distortion of the internal electrostatic configuration of the units. The coupling systems which account for these attractions are pairs of electron orbits. In this respect, the present theory is closely allied to the cubical atom theory of Lewis (A., 1916, ii, 310) and Langmuir (A., 1919, ii, 328), in which the most stable electron arrangement is that of a pair. Tyndall's discovery relating to the characteristic deportment of diamagnetic and paramagnetic substances in a magnetic field has been confirmed for a few organic compounds, and the interpretation of the results on the electron theory implies that, both in diamagnetic and paramagnetic crystals, the planes of the electron orbits have a greater aggregate projection perpendicular to the principal cleavage than parallel to it. Thus the existence of multiple cleavages demands a spacial distribution of electron orbits. Moreover, as the molecules are most closely packed in a direction parallel to the principal cleavage, the isolation of all the cleavages by suitably suspending the crystal in a magnetic field really isolates the unit of crystal structure. This unit is the chemical molecule. Crystals of the simple cubic form, for which *X*-ray analysis indicates an ionised atomic structure rather than a molecular structure, show no appreciable structural deportment in the magnetic field. It is probable that hydrogen and helium atoms when radiating are in a very different state from unexcited matter on which the magnetic observations have been made. In this work, the matter is in the normal state, and each atom contains at least one electron within the active range of another electron in an adjacent atom, and the mutual interaction of such systems must be taken into account. Some factor seems to

have been neglected in Bohr's hypothesis, which, though of little importance when the atoms contain only one electron each and are independent of each other, yet is of first importance for matter in the normal state, and without which it is impossible to explain either the magnetic properties of crystals or crystal structure. The attraction between exactly similar atoms, the directed valencies required by stereochemistry, and the directive forces within crystals are explicable only by a due recognition of the magnetic forcive in material media. It is probable that the Laplace intrinsic pressure in liquids and in isotropic gels is due to electrostatic doublets of atomic dimensions. When crystallisation occurs, superimposed on the electrostatic stresses are the directional stresses due to the magnetic doublets, which, for a given molecule, determine a characteristic crystalline symmetry, and, owing to their highly localised nature compared with the electrostatic doublets, determine the rigidity of the crystal. Such highly localised magnetic doublets suggest either that the conventional electron is moving in an orbit very small compared with atomic dimensions, or that the electron itself is a complex unit endowed with specific magnetic and electrostatic properties, that is, the electron is also a magneton.

J. F. S.

Critical Constants of Mercury and Increase of Molecular Attraction on Dissociation of Double Molecules. I. and II. J. J. VAN LAAR (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 267—281, 282—298. Compare A., 1918, ii, 8).—I. The critical temperature of mercury is estimated to be 1700°, the critical pressure at least 1100 atm., and the critical density about 4·15. At the critical point, mercury consists of Hg_2 and Hg. These conclusions are shown by calculation to be in accordance with other magnitudes. II. A mathematical consideration of the case of dissociation of double molecules from the point of view of thermodynamics and Van der Waals's equation. The results are applied to the case of mercury. J. R. P.

Critical Temperature and Pressure of some Substances. J. J. VAN LAAR (*J. Chim. Phys.*, 1920, **18**, 273—282).—A theoretical paper in which methods of calculating the critical temperature and pressure from existing data are discussed and applied in a number of cases. The following values have been deduced and discussed in connexion with the existing experimental values: hydrogen fluoride, T_c 497·4°, p_c 99·6 atm.; hydrogen chloride, T_c 324·5°, p_c 81·7 atm.; hydrogen bromide, T_c 363·0°, p_c 74 atm.; and hydrogen iodide, T_c 423·5°, p_c 70 atm. J. F. S.

Some Relationships between the Absolute Values of the Critical Temperature and Boiling Point. MAURICE PRUD'HOMME (*J. Chim. Phys.*, 1920, **18**, 270—272).—The author has calculated the values of the constants of the three expressions $T_1/T_c=K_1$, $T_c/(T_c-T_1)=K_2$, $T_c/(T_c-T_1).T_c/T_1=K_3$ for a number of elements and compounds. The two expressions

$(T_c - T_1) . T_c/T_1 = \text{const.}$ and $T_1 . (T_c - T_1)/T_c = \text{const.}$ are derived. These hold for homologous series; the former, for paraffins, chlorinated paraffins, olefines, ethers, aliphatic amines, and nitriles, and the latter for methylbenzenes, other substituted derivatives of benzene, esters, brominated paraffins, iodated paraffins, and phenols. It is also shown that between the three constants K_1, K_2, and K_3 the following relationship exists: $K_3 - K_2 = 1/K_1 = T_c/T_1$ or $K_1(K_3 - K_2) = 1$. J. F. S.

Relationship between the Absolute Values of the Critical Temperature, the Boiling Point, and the Melting Point. MAURICE PRUD'HOMME (*J. Chim. Phys.*, 1920, **18**, 307—310).—The author has applied similar relationships to those existing between the boiling point and the critical temperature to the freezing points. The expressions are $T_f/T_c = K_1'$, $T_c/(T_c - T_f) = K_2'$, and $T_c/(T_c - T_f) . T_c/T_f = K_3'$ (see preceding abstract). It is shown that the expressions $T_c^2/T_1(T_c - T_1)$ and $T_c^2/T_f(T_c - T_f)$ are characteristic functions of both elements and compounds. They have not generally the same value, but the ratio between them is fairly constant for elements of the zero and seventh groups, and for many groups of analogous or homologous compounds. The expression $T_f(T_c - T_f) = rT_1(T_c - T_1)$ is stated to represent a general law, in which r is a constant having a value between 1·0 and 1·1. When $r = 1$, the expression becomes $T_c = T_f + T_1$, that is, the critical temperature is equal to the sum of the boiling point and the freezing point, all values being in absolute degrees. This is found to be the case for water, phosphine, methyl bromide, chlorobenzene, and acetone. Similar relationships are also found in the case of iron, copper, and gold, and in this case the above-mentioned empirical relationship is deduced theoretically. J. F. S.

Surface Energy, Latent Heat, and Compressibility. D. L. HAMMICK (*Phil. Mag.*, 1921, [vi], **41**, 21—32).—A theoretical paper in which expressions representing the surface energy, latent heat, and compressibility of liquids are deduced mathematically. The results obtained are tested by means of existing data, on ethyl ether, benzene, carbon tetrachloride, carbon disulphide, chloroform, ethyl acetate, ethylene dichloride, ethyl iodide, chlorobenzene, toluene, and nitrobenzene. It is shown that if the van der Waals's constant a is independent of volume, the compressibility, β, of a liquid should be connected with the internal latent heat by the expression $1/\beta J = -2\lambda_1 s$ (i), in which λ_1 is the internal latent heat and s the specific gravity. If a is a function of v, then $1/\beta J = \epsilon\lambda_1 s$ (ii), where $\epsilon = \rho/a$ and $\rho = 1/\rho . \partial\rho/\partial T$, that is, the coefficient of variation of surface energy with temperature, and $a = 1/v\partial v/\partial T$, the coefficient of cubical expansion. It is found for the liquids examined that the expression (i) is approached at higher temperatures, the expression holding for some liquids at the boiling point, whilst (ii) becomes progressively applicable at low temperatures. Lewis's empirical approximation (*Zeitsch. physikal. Chem.*, 1911, **78**, 24),

that the heat of compression is very nearly equal to the latent heat of vaporisation per unit volume at 0°, is deduced. The approximate constancy of the product of the compressibility and surface energy at 0° is deduced, and the observed lack of constancy at other temperatures is explained. J. F. S.

The Melting Point of Heptane and the Law of Alternance of Melting Points. R. DE FORCRAND (*Compt. rend.*, 1921, **172**, 31—34).—A redetermination of the melting point of *n*-octane gives the value −57·4° (compare Guttmann, A., 1907, i, 458, who found −98·2°). A sample of heptane gave the values: b. p. 98·8°/760 mm.; m. p. −94·75°; D_4^0 0·7010. These values, taken in conjunction with the m. p.'s of the other members of the methane series of hydrocarbons, show that the m. p.'s of these hydrocarbons conform to the law of alternance from CH_4 to C_6H_{14}, and from C_7H_{16} to $C_{24}H_{50}$ they show a continuous rise, the rise always being greater from a hydrocarbon containing an odd number of carbon atoms to one containing an even number than vice versâ. The corresponding cyclic hydrocarbons from the C_3 to the C_8 member show the same alternance, and the author deduces for *cyclo*butane the approximate m. p., −50°. In the case of the silanes the m. p.'s show a continuous rise on ascending the series, but the rise is greater in passing from SiH_4 to Si_2H_6 or from Si_3H_8 to Si_4H_{10} than in passing from Si_2H_6 to Si_3H_8. W. G.

Distillation and Rectification. L. GAY (*Chim. et Ind.*, 1920, **4**, 735—748).—The author deals with the distillation of a mixture of three constituents and the continuous separation of these in different phases; methods and formulæ are given for calculating the composition of the different phases, and certain rules have been established concerning the minimum and maximum heat compatible with the correct operation of the fractionating and rectifying column. W. P. S.

Internal Energy of Inflammable Mixtures of Coal Gas and Air after Explosion. W. T. DAVID (*Proc. Roy. Soc.*, 1921, **98**, [*A*], 303—318).—In the first part of the paper the heat-loss measurements by conduction and by radiation made during the explosion and subsequent cooling of mixtures of coal gas and air of various compositions have been combined. The heat loss by conduction is 40—60% greater than the loss by radiation in the experimental vessel. In a vessel rather more than twice as large, the two losses would be equal, and in a still larger vessel the radiation loss would be the greater. Formulæ have been deduced whereby the total heat loss up to the moment of maximum pressure and the rate of heat loss at any temperature during cooling may be calculated from data obtained from the pressure–time curves. In the second part of the paper the heat-loss measurements have been applied to the estimation of the internal energy and the volumetric heat of the different mixtures at various temperatures after explosion. An

examination of the internal energy and volumetric heat curves so obtained indicates that at the moment of maximum pressure about 10% of the heat of combustion of the coal gas in each mixture has not been converted into thermal energy, and that after-burning continues for at least 0·25 sec. after the maximum pressure has been attained. These results show that the energy of combustion of the coal gas originally in the vessel is distributed at the moment of maximum temperature as follows: (1) Internal energy (thermal) from about 72% of the heat of combustion of the coal gas in a 9·7% mixture to about 80% in a 15% mixture. (ii) Available chemical energy, about 10% in each mixture. (iii) Heat loss to walls of vessel, from about 10% in a 15% mixture to about 18% in a 9·7% mixture. J. F. S.

A Determination, by means of a Differential Calorimeter, of the Heat produced during the Inversion of Sucrose. HENRY H. DIXON and NIGEL G. BALL (*Sci. Proc. R. Dubl. Soc.*, 1920, **16**, 153—164).—Using an apparatus similar in character to that of Hill (A., 1912, ii, 20), the differential calorimeter being formed by two vacuum flasks, the temperature measurements being made with a thermo-electric couple (compare Dixon, A., 1911, ii, 853), the authors have determined the heat of inversion of sucrose by invertase, and obtain the value 3·83 cal. per gram-molecule, which is in close agreement with the value obtained by Brown and Pickering (T., 1897, **71**, 783). Attempts to obtain a value for the heat of reaction during the hydrolysis of maltose were not successful. W. G.

The Fundamental Constants of Nature. HAWKSWORTH COLLINS (*Chem. News*, 1921, **122**, 2—4).—Evidence is brought forward to prove that the boiling points are not suitable temperatures for comparison of the molecular volumes of substances. J. R. P.

Viscosity-Concentration Function of Poly-disperse Systems. H. LÜERS and M. SCHNEIDER (*Kolloid Zeitsch.*, 1920, **27**, 273—277).—Viscosity measurements of mixtures of water and barley flour up to a concentration of 24 grams in 100 c.c. of solution have been made at 20°. It is shown that this case, as well as other complicated poly-disperse systems, are represented by the empirical equation $\eta_s=\eta_0(1+kf+k_1f^n)$, in which η_s is the viscosity of the suspension, η_0 that of water $(=1)$, f the volume relationship of the disperse phase to the total volume, k, k_1, and n are constants. This expression is similar to that put forward by Wo. Ostwald and Mündler for the osmotic pressure of dispersoids (A., 1919, ii, 185). The present system is also satisfactorily represented by the theoretically deduced formula $\eta_s=\eta(1-aK)$ (Hess, this vol., ii, 18), in which η_s is the viscosity of the suspension, η that of the dispersion medium, K the quantity of disperse phase in unit volume of the suspension, and a a factor which converts K into the functioning volume of the disperse phase. J. F. S.

Surface Tension and Molecular Attraction. The Adhesional Work between Mercury and Organic Liquids. WILLIAM D. HARKINS and E. H. GRAFTON (*J. Amer. Chem. Soc.*, 1920, **42**, 2534—2538).—The surface tension of mercury in air, water, ethyl alcohol, ethyl ether, octyl alcohol, nitroethane, nitrobenzene, carbon disulphide, carbon tetrachloride, chloroform, methylene chloride, ethylidene chloride, ethylene dibromide, acetylene tetrabromide, methyl iodide, ethyl iodide, benzene, hexane, and octane has been determined at 20° by the method previously used by Harkins and Brown (A., 1919, ii, 221). From the results the adhesional work is calculated by means of the formula $W_A = -\Delta\gamma = \gamma_1 + \gamma_2 - \gamma_{1,2}$, in which W_A is the adhesional work, $-\Delta\gamma$ the decrease in free energy when the surfaces of the two liquids come together, γ_1 and γ_2 are the free surface energies per sq. cm. of the two liquids, and $\gamma_{1,2}$ is the free surface energy of the interface. The surface tension of mercury in air at 20° is 464·9 dynes, whilst in water the value is 374·8 dynes; the adhesional work in water is 182·6 ergs.

J. F. S.

Surface Energy of Mercury and the Energy Relations at the Interface between Mercury and other Liquids. WILLIAM D. HARKINS and WARREN W. EWING (*J. Amer. Chem. Soc.*, 1920, **42**, 2539—2547).—The surface tension of mercury in a vacuum has been determined at 0°, 10°, 20°, 30°, 40°, 50°, and 60° by the drop-weight method, and from the results the free energy of surface formation, the latent heat of surface formation, and the total energy of surface formation have been calculated. The entropy of surface formation is 0·22 ergs per degree per sq. cm. The interfacial tensions between mercury and a number of organic liquids have been determined at 20° by the drop-weight method. The results of the present work and the previous work (see preceding abstract) indicate that the adhesional work between a mercury surface and the surface of an organic liquid is always greater than that between the organic liquid and water, and also greater than that between the organic liquid and itself, that is, the cohesional surface work. In about half the cases examined the difference between the adhesional work against mercury and that against water is nearly constant, and lies between 80 and 90 ergs, so that the work of attraction is by no means entirely specific. The adhesional work decreases rapidly with increase of temperature, whilst the total adhesional energy increases. The latent heat of the interface between mercury and another liquid decreases rapidly as the temperature increases, whilst the latent heat of most ordinary surfaces increases with the temperature, and the total energy of interface formation also decreases, although not so rapidly. J. F. S.

Surface Tension of Oil-Water Interfaces. H. HARTRIDGE and R. A. PETERS (*Proc. Physiol. Soc.*, Oct. 16, 1920; *J. Physiol.*, **54**, xli).—The surface tension between olive oil and water depends greatly on the reaction of the water. Near the neutral point

there is a fall in the surface tension of about 35% for an increase of 1 in the P_H. It is hoped to base on this a means for determining the hydrogen-ion concentration of physiological fluids.

G. B.

The Surface Tension of certain Soap Solutions and their Emulsifying Power. MOLLIE G. WHITE and J. W. MARDEN (*J. Physical Chem.*, 1920, **24**, 618—629).—The surface tensions of solutions of sodium stearate and sodium palmitate were determined. Solutions of soap decrease in surface tension as they increase in concentration, whilst solutions of sodium hydroxide and many salts show the opposite behaviour. The relative emulsifying power of solutions of sodium palmitate and sodium stearate for petroleum and linseed oil was determined by shaking by hand for five minutes and observing the time of noticeable separation. With increase of concentration of the soap solution, there is an increase of emulsifying power, or, as the surface tension increases, the emulsifying power decreases. The viscosity has considerable influence on the permanency of the emulsions. The presence of glycerol does not affect the surface tension to any large extent, and should have no deleterious effect on the cleansing power of soap. A large amount of sodium carbonate, however, raises the surface tension, and would not be desirable in cleansing soaps.

J. R. P.

Absorption by Coagulation. F. DEZEINE (*J. Pharm. Belg.*, 1920, **2**. 238—240, 257—258, 281- 282, 305 -307, 329—332, 349—351, 389—390, 433—444).– Largely a theoretical discussion with a summary of the literature. The author has prepared dispersed copper sols by the Bredig method, and considers that the instances in which the disperse copper differs in chemical reaction from compact copper, as with acids and salt solutions in which copper ions or basic copper precipitates are formed without any evidence of a reducing action, may be explained by an action of the dissolved oxygen on the very extensive surface of the copper.

CHEMICAL ABSTRACTS.

Charcoal Activation. H. HORTON SHELDON (*Physical Rev.*, 1920, **16**, 165—172).—The first part of this paper comprises a study of the heat effect on the adsorption of hydrogen and nitrogen by charcoal, and is a continuation of the work of Lemon (A., 1920, ii, 167), in which air was used. The charcoal is heated for periods of one to twenty hours at 400—1000°, and, at the same time, the gases given off are pumped out with a mercury condensation pump. The activity of the charcoal is tested after each treatment by its adsorption of gas at liquid-air temperature, and the results are shown by curves, in which the logarithm of time in minutes is plotted against the logarithm of pressure in cm. The results obtained are in agreement with the hydrocarbon theory of activation proposed by Chaney. The second part of the work consisted

in the formation of a charcoal which adsorbed hydrogen more abundantly than nitrogen. This was done merely by heating at 1000° for about 3·5 hours in a vacuum maintained by continuous pumping with a mercury condensation pump. The apparent difference between the adsorption of hydrogen and of nitrogen is believed to be due to a secondary action in the first case, which is either a chemical action, or, as McBain believes, the formation of a solid solution. It is, however, reasonable to conclude that surface condensation is the principal action in the case of both gases.

CHEMICAL ABSTRACTS.

Adsorption by Precipitates. III. HARRY B. WEISER and EDMUND B. MIDDLETON (*J. Physical Chem.*, 1920, **24**, 630—663. See A., 1920, ii, 760).—The precipitation of colloidal alumina by electrolytes and the adsorption of the precipitating ions by the hydrous oxide were investigated. The results confirm those obtained with ferric oxide. The precipitating concentrations of a number of electrolytes for colloidal hydrous aluminium oxide were determined, and, on the assumption that the most readily adsorbed ion precipitates in the lowest concentration, and vice versa, the order of adsorption of anions deduced from the precipitation values, expressed in equivalents, is found to be: ferrocyanide, thiosulphate, ferricyanide, citrate, sulphate, oxalate, phosphate, chromate, dithionate, dichromate, chloride, nitrate, bromide, iodide.

The adsorption of multivalent ions, not readily removed by washing, was determined by direct analysis of the precipitate. The amounts of various anions carried down were not even approximately equivalent. Although the adsorption of equivalent amounts will neutralise a given amount of colloid, the actual amounts carried down will not be equivalent, since the amounts adsorbed by the neutralised particles vary with the adsorbability of the ions. The order of adsorption, beginning with the ion most adsorbed, is: phosphate, ferrocyanide, ferricyanide, oxalate, sulphate, chromate, thiosulphate, dithionate, dichromate. The order deduced from the precipitation values is not the same as that found by analysis, since the precipitation values are not determined exclusively by the valency and adsorbability of the ions.

The conversion of potassium dichromate into chromate in the presence of powdered alumina, noticed by Ishizaka (A., 1913, ii, 486), is explained by the disturbance of the equilibrium $Cr_2O_7'' + H_2O \rightleftharpoons 2H^{\cdot} + 2CrO_4'$ by the strong preferential adsorption of hydrion by the alumina. Colloidal alumina stabilised by preferential adsorption of hydrion has a comparatively slight effect on the equilibrium.

J. R. P.

Adsorption of Aniline Dyes and Inorganic Salts by Solutions of Lecithin. J. CRUICKSHANK (*J. Path. Bact.*, 1920, **23**, 230—232).—Ethyl ether alone did not remove dyes from aqueous solution. Solutions of lecithin in ether were very active in taking up dyes from aqueous solution. With suitable concentrations of

lecithin, practically all the dye could be removed. Very small amounts of lecithin exert this action; 0·00001 gram in 2 c.c. extracted a sufficient amount of brilliant-green and other dyes from 1% solutions to be detectable. Acid dyes were only slightly adsorbed. Various oils, fats, fatty acids, and soaps failed to exhibit this property, except that oleic and linoleic acids in large amounts produced slight coloration of the ethereal solutions. Cholesterol gave no evidence of adsorbent power. All results were the same when solutions were made in benzene or chloroform instead of ether. Potassium iodide, bromide, chromate, thiocyanate, ferro- and ferri-cyanide, sodium chloride, iodide, nitroprusside, arsenate, salicylate, and other salts were adsorbed from aqueous solution by ethereal solutions of lecithin. Quinine and strychnine were readily taken up, but codeine and morphine were not. Kephalin acted like lecithin. CHEMICAL ABSTRACTS.

Anomalous Osmosis with Gold Beaters' Skin Membranes. Chloride Solutions in the Presence of Acids and Bases. F. E. BARTELL and O. E. MADISON (*J. Physical Chem.*, 1920, **24**, 593—607).—The conclusions formerly arrived at (A., 1916, ii, 377, 388; 1920, ii, 595) have been confirmed by a study of the effects of different concentrations of acids and bases on the osmose of salt solutions. If the fundamental hypothesis is correct, it should be possible to change the osmotic effects of salt solutions by altering the sign of the charge on the membrane by addition of acids and bases. The same salts, apparatus, and methods were used as in previous experiments, and the expected results were found. The presence of acid or alkali may alter, not only the electrical sign of the capillary wall system, but also that of the membrane system. The direction of osmosis, and also its magnitude, are closely related to the electrical orientation of the cell system. The results are represented in tables and curves. J. R. P.

The Dissolution of Sodium Chloride and Sodium Chlorate Crystals. WALTER POPPE (*Jahrb. Min.*, 1914, *Beil. Bd.*, **38**, 363—428).—Experiments were made to test Johnsen's theory of the growth and dissolution of crystals, which is founded on the assumption that, under constant conditions, each crystal form has a constant velocity of growth or dissolution in a direction normal to the surface of the crystal face. The experiments were made by attaching the crystal to a horizontally revolving surface in a solution of the salt at 30°, undersaturated to a known extent (0·5% to 2·0%), and at stated intervals withdrawing the crystal and measuring its linear dimensions, and, when possible, the angles between the vicinal faces which developed. It was found that, with 0·5% and 1·0% undersaturated solutions, each crystal form dissolved with a specific constant velocity, but with 2% undersaturation the rates of dissolution of all faces became approximately equal, and the faces all became so rounded that it was impossible to measure the angles between them.

When a crystal of rock-salt, in the form of a cleavage cube, was placed in a 0·5% or 1% undersaturated solution, each cube face was replaced by four flat pyramid faces of the form $\{h10\}$, where h varied from 46 to 164. These faces, in turn, were gradually replaced by icositetrahedral faces having indices of the order $\{14.1.1\}$ to $\{23.1.1\}$. Experiments were also made in which the original crystal was a combination of cube and dodecahedron or octahedron. The dodecahedron had about the same solution velocity as the cube face, but that of the octahedron was much slower. Consequently, the octahedron faces quickly disappeared, since the final crystal faces are those which have the greatest solution velocity. The final crystal was an icositetrahedron.

Cubes of sodium chlorate in an undersaturated solution were transformed into a combination of two flat pentagondodecahedra, in agreement with the tetartohedral character of the crystal. In the course of the work, the solubility of sodium chlorate in water at 30° was redetermined, and found to be 104·6 grams per 100 grams of water, instead of 111·25 grams, as obtained from Landolt-Bernstein's tables. The saturated solution has D^{30} 1·450, and 100 c.c. contains 74·13 ± 0·007 grams of sodium chlorate.

The results are discussed at some length, especially as regards their bearing on Noyes and Whitney's formula for the rate of solution of a solid (A., 1897, ii, 479). It cannot be concluded from the results that different faces of a crystal actually have different solubilities. If such different solubilities do exist, it is probably only when the particles are very small. E. H. R.

Nature of the Cleavage of Crystals. GEORG WULFF (*Physikal. Zeitsch.*, 1920, **21**, 718—720).—A theoretical paper in which the author makes the assumption that the cleavage of crystals occurs in planes of weak cohesion, due to a weak affinity. Thus, in the case of a binary compound AB of univalent elements, there are two methods in which an atom chain in a crystal may be arranged, $A—B—A—B—A—B$ . . . and

$A—B—B—A—A—B$ . . . ;

in the first arrangement there is no obvious position where cleavage might by preference take place, but in the second arrangement it is likely to occur between similar elements, in the positions $B—B$ or $A—A$, on account of decreased attractive force. The hypothesis is developed in the case of fluorspar, rock-salt, calcspar, zinc blende, diamond, and sulphur; diagrams representing the arrangement in these cases are given, and the cleavage planes deduced.

J. F. S.

The Existence of Equidistant Differentiated Planes Normal to the Optic Axis in Anisotropic Liquids (Liquid Crystals). F. GRANDJEAN (*Compt. rend.*, 1921, **172**, 71—74).—To explain the colours given by reflection by negative anisotropic liquids, authors have suggested a division of these liquids into parallel plates of constant thickness, at the surface of

which the light will be reflected. The author shows that such plates are distinctly visible under the microscope in the case of amyl cyanobenzylideneaminocinnamate. The liquid is examined in a cleavage crevice of some mineral, such as mica or talc, having a perfect cleavage. For this ester, the equidistances between the bands are $1 \cdot 88 \times 10^{-5}$ cm. at 92°, the m. p. of the solid crystals, and $2 \cdot 18 \times 10^{-5}$ cm. at 105°, the temperature of transformation into an isotropic liquid. W. G.

Swelling of Colloidal Mixtures. I. HANS HANDOVSKY and ARTHUR WEIL (*Kolloid Zeitsch.*, 1920, **27**, 306—311).—The maximum swelling of 20% gelatin jellies and the influence of charcoal and lipoid substances on the jellies have been examined. It is shown that the addition of animal charcoal in quantities up to 33% to 20% gelatin jellies has no effect on the swelling, and that charcoal and gelatin form complexes each with its own power of swelling. Similar conclusions are reached in the other mixtures examined.
J. F. S.

Colloid Chemical Action of Salts of the Rare Earths and their Relationship to the Precipitation Reaction of the Anti-Substances. R. DOERR (*Kolloid Zeitsch.*, 1920, **27**, 277—292).—The behaviour of the salts of thorium, cerium, praseodymium, and lanthanum has been examined in connexion with a large number of colloidal substances, such as sera of a number of animals. The salts examined agglutinate suspensions of cells (red blood corpuscles, bacteria, and spores), and precipitate albumin sols. This happens when the salt is present as a typical crystalloid and also when the salts are not hydrolysed in the solution. Agglutination and precipitation take place with very small concentrations of salts (1 part of thorium sulphate to 5000—10,000 parts of the colloidal mixture). Quadrivalent cations (Th) act more strongly than tervalent cations (Ce. La, Pr); still, the precipitating power does not depend only on the valency, but also on other unknown properties of the cations of the rare earths and on the particular constitution of the albuminous substance. The salts examined are toxic toward both plant and animal protoplasm. The poisonous character is conditioned by the valency (Th more poisonous than Ce) of the cation, by the nature of the cation, and by the sensitiveness of the living cell. Different cells show very different powers of resistance; spirochætes are much more resistant than typhus baccilli. The mechanism of the poisoning is not due to the simple coagulation of the albumin, for in the presence of excess of albumin the coagulation is reversible, but the poisoning is not. Spores of bacteria and fungi are not attacked because of the impermeability of their membranes. The ease with which these substances agglutinate indicates that this process is a surface reaction. The coagulation of albumin by the salts of the rare earths is retarded by an excess of one of the reacting substances. For the maximum relationship at which coagulation will occur there is a minimum salt concentration, below

which no coagulation can take place. This concentration lies lower for the thorium cation than for cerium, praseodymium or lanthanum. The coagulation depends on the formation of loose compounds of albumin and salt (cerium albuminate), similar to those formed with the heavy metals. These compounds are colloid-chemically inactive and easily reversible; they dissolve readily in an excess of either component, and in this the different sorts of albumin, as well as the different cations, can replace one another. The dissolving power of the cations is proportional to the coagulating power. Thorium salts dissolve much better than cerium salts. The analysis of such precipitates by means of Löwe's interferometer shows that the quantity of substance coagulated does not depend only on the relative concentration, but also on the cation of the salt, and in the case of thorium is three times as great as that produced by twenty times the quantity of cerous chloride.

J. F. S.

Simple Method of Preparing Ultra-filters. ERICH KNAFFL-LENZ (*Kolloid Zeitsch.*, 1920, **27**, 315—316).—An ultra-filter for use with a Buchner funnel or a Gooch crucible may be prepared as follows: Into a crystallising dish of the same internal diameter as the Buchner funnel, or into a porcelain crucible of the same internal diameter as the Gooch crucible, a 3% solution of collodion is poured and equally distributed by rotation of the dish. As soon as the ether has evaporated, the dish is filled with water three or four times, and finally the membrane is removed by loosening it at the edges and allowing water to flow between it and the glass. It is then placed in the Buchner funnel, which contains a filter paper, and carefully pressed on to the sides and bottom. J. F. S.

Studies in Emulsions. II. The Reversal of Phases by Electrolytes, and the Effects of Free Fatty Acids and Alkalis on Emulsion Equilibrium. SHANTI SWARUPA BHATNAGAR (T., 1921, **119**, 61—68).

Double Saline Decompositions and the Law of Phases. ÉTIENNE RENGADE (*Compt. rend.*, 1921, **172**, 60—62. Compare A., 1917, ii, 451).—In a discussion of Raveau's work (this vol., ii, 31) the author considers the effect of the addition of a small amount of water to a mixture of sodium nitrate and ammonium chloride. From results obtained by adding crystals of sodium nitrate to a saturated solution of ammonium chloride, or by shaking an excess of sodium nitrate (0·588 mol.) and ammonium chloride (0·467 mol.) with a little water, it is shown that at the ordinary temperature there are only two ternary mixtures, namely,

$$NaNO_3\text{–}NH_4{\cdot}NO_3\text{–}NH_4Cl$$

and $NaNO_3$–NH_4Cl–$NaCl$, which can exist without change in contact with a small amount of water. All other mixtures of the two, three, or four salts, containing the four ions, decompose, giving, according to the conditions, one or other of the ternary mixtures.

In general, when any two salts with different ions, belonging to a "stable couple," are in contact with water, a third solid salt will appear or not, according as the concentration of this third salt in solution is superior or inferior to its actual solubility. W. G.

Corrosive Action of Chlorine-treated Water. I. The Effects of Steel on the Equilibrium: $Cl_2 + H_2O \rightleftharpoons HCl + HClO$, and of Products of the Equilibrium on Steel. GEORGE L. CLARK and R. B. ISELEY (*J. Ind. Eng. Chem.*, 1920, **12**, 1116—1122).—Rusting of steel occurs in water free from chlorine and is caused by the presence of dissolved oxygen. In the presence of chlorine, the most active agent is hypochlorous acid, which disappears first from the solution; rust is formed rapidly during the disappearance, and then practically ceases when the concentration of hydrochloric acid becomes constant. This indicates an equilibrium, $FeCl_3 + 3H_2O \rightleftharpoons Fe(OH)_3 + 3HCl$. It has been shown that the reaction $H_2O + Cl_2 \rightleftharpoons HOCl + HCl$ proceeds very slowly and comes to equilibrium. In deciding whether iron actually acts as a catalyst in materially hastening the final attainment of equilibrium in this reaction, it is apparent that, in the presence of chloride, the iron is present almost completely in the form of ferric ion, and that the concentration of ferrous ion which can react with ClO^- is very small. The effect of iron is, therefore, practically entirely chemical rather than catalytic in nature. W. P. S.

The Fusion of Potassium Salts and Mixtures of Salts containing Water of Crystallisation. I. and II. E. JANECKE (*Kali*, 1916, **10**, 371—375; 1917, **11**, 10—13, 21—26; from *Jahrb Min.*, 1920, i, *Ref* 262—263, 263—265).—I. The separation of the melt and residue in the incongruent fusion of potassium salts and mixtures with other salts as effected in a special apparatus under pressure. A diminution of pressure was observed at the melting point Gypsum, $CaSO_4,2H_2O$, exhibits incongruent fusion at 128—130°, the solution pressed out being very dilute and the residue having the composition $CaSO_4,\frac{1}{2}H_2O$. The hydrate, $MgSO_4,7H_2O$, is in equilibrium at 51° with a melt of given composition and the hydrate, $MgSO_4,6H_2O$, which may be separated by pressing. The hexahydrate shows an anomaly in its incongruent fusion, since the equilibrium at 68° between this salt, kieserite, and melt can readily be superheated. The pressed residue contains so much mother liquor as to lead to the suspicion of the formation of an intermediate hydrate. The displacement of the incongruent melting point by pressure is also possible.

II. The behaviour of other salt pairs in the pressure apparatus was studied, including the fusion of kainite, of a mixture of kainite and carnallite, and the transition of a mixture of reichardtite, sylvine, and carnallite into kainite and melt. The incongruent fusion of kainite occurs theoretically at 85°; in many cases 155—165° was reached under pressure; the transition temperature of kainite and carnallite may also be much above the theoretical value according to the conditions. By very slow heating the theoret-

ical values are found. In the formation of the Stassfurt deposits the melts formed by incongruent fusion may have been pressed out and thus the reverse changes prevented. The influence of pressure may also have been present. J. R. P.

Ternary Systems with Three Solid Phases of a Special Kind. The Systems (Ba-K-Na)Cl, Mg-Cd-Zn, and similar Cases. ERNST JANECKE (*Jahrb. Min.*, 1914, *Beil. Bd.*, 38, 501—512).—The paper is devoted to a theoretical discussion of the equilibrium conditions in ternary systems, in which, of the three components, *A*, *B*, and *C*, *A* and *C* are completely miscible, another pair, *B* and *C*, form a binary eutectic, whilst the remaining pair, *A* and *B*, form a compound. The system $KCl-BaCl_2-NaCl$ is a typical example. Assuming that KCl and NaCl form a continuous series of mixed crystals in the ternary mixture, the only three solid phases which can appear when this ternary system crystallises are mixed crystals KCl + NaCl, the compound $BaCl_2,2KCl$, and $BaCl_2$. These three phases correspond with three areas in the triangular equilibrium diagram, separated from one another by three curves which meet in an invariant point *E*, which in this case is a eutectic point in equilibrium with the three phases, $BaCl_2$, $BaCl_2,2KCl$, and mixed crystals of sodium and potassium chlorides of a particular composition, called by the author the "principal mixed crystal." According to Gemsky, who investigated this system (A., 1914, ii, 51), potassium and sodium chlorides do not form a continuous series of mixed crystals in the ternary system, but two series, one rich in sodium and the other rich in potassium, with a gap between. This opinion is criticised by the author on the ground that it leads to results contradictory to the phase rule, since four phases appear in equilibrium at the invariant point *E*. Gemsky's results may be explained on the assumption that complete equilibrium between the solid and liquid does not obtain during crystallisation, with the result that mixed crystals of varying composition appear. The equilibrium diagram of the system Mg-Cd-Zn is discussed, and also similar theoretical cases in which the invariant point becomes a ternary transition point, instead of a eutectic point. E. H. R.

The System Barium Chloride-Potassium Chloride-Sodium Chloride. E. VORTISCH (*Jahrb. Min.*, 1914, *Beil. Bd.*, **38**, 513—524. Compare preceding abstract).—Further experiments have confirmed Gemsky's results (*loc. cit.*). The existence of two series of mixed crystals of sodium and potassium chlorides in the ternary mixture does not conflict with the phase rule. Shortly before the eutectic crystallisation a resorption of the mixed crystals rich in potassium chloride occurs, so that only three solid phases are in equilibrium at the invariant point. This conclusion was confirmed by microscopic examination of thin sections. E. H. R.

The System Barium Chloride-Potassium Chloride-Sodium Chloride. ERNST JANECKE (*Centr. Min.*, 1919, 271—274). —Polemical, in reply to Vortisch (preceding abstract). Mixed

crystals of potassium and sodium chlorides begin to separate in the solid state only below 375°, and since the eutectic temperature is 542°, it follows that no separation can take place before the eutectic crystallisation. It is demonstrated mathematically, with the help of the thermodynamic potential (*Z*-function), that the system under consideration conforms to the type of ternary system to which it was previously assigned by the author. E. H. R.

Mixed Crystals (K,Na)Cl in Ternary Systems. ERH. VORTISCH (*Centr. Min.*, 1919, 293—299); ERNST JÄNECKE (*ibid.*, 358).—Vortisch replies to Jänecke (preceding abstract). It is shown that in other ternary systems, in particular the system $CdCl_2$–KCl–NaCl, a gap occurs in the mixed crystal series NaCl–KCl. It has been shown by Nacken (A., 1919, ii, 281) that the limiting temperature of complete miscibility of potassium and sodium chlorides is probably 500°, not 375°. In presence of a third component this limiting temperature is probably raised considerably, and the gap in the mixed crystal series found by Gemsky in the ternary system $BaCl_2$–KCl–NaCl is thus accounted for.

To this, Jänecke replies briefly. E. H. R.

Thermal and Crystallographic Investigation of the Ternary Systems Lithium Chloride-Sodium Chloride-Potassium Chloride and Calcium Chloride-Strontium Chloride-Barium Chloride. WALTER SCHAEFER (*Jahrb. Min.*, 1919, *Beil. Bd.*, **43**, 132—189).—The melting points of the pure substances were redetermined: lithium chloride, 609°; sodium chloride, 802°; potassium chloride, 774°; calcium chloride, 773°; strontium chloride, 870°; barium chloride, 960°.

I. *The System* LiCl–NaCl–KCl.—Lithium and potassium chloride form neither compounds nor mixed crystals; the eutectic point is at 361° with 58 mols. % KCl. Lithium and sodium chlorides form a continuous series of mixed crystals, the melting point minimum being 552° with 72 mols. % LiCl. Sodium and potassium chlorides are also completely miscible, the m. p. minimum being 661° with 50 mols. % NaCl. In both these cases miscibility is incomplete at lower temperatures; in the first case the limiting miscibility curve has a maximum at 271° with 58 mols. % LiCl, and in the second case 402° with 50 mols. % NaCl. Above these maxima miscibility is complete. The ternary triangular diagram is bounded on two sides (LiCl–NaCl and NaCl–KCl) by narrow areas of complete miscibility, the remainder of the diagram being an area of incomplete miscibility, with a eutectic point at the concentration LiCl, 51·5 mols. %; NaCl, 11·5 mols. %; KCl, 37 mols. %.

II. *The System* $CaCl_2$–$SrCl_2$–$BaCl_2$. — Calcium and barium chlorides form a double salt, $CaCl_2,BaCl_2$, which is immiscible in the crystalline state with its components. There is a eutectic point at 602° with 38 mols. % $BaCl_2$. Calcium and strontium chlorides form a continuous series of mixed crystals with a minimum at 66 mols. % $CaCl_2$. At lower temperatures separation takes place, the maxi-

mum temperature on the limiting miscibility curve being 543°. Barium and strontium chlorides are also completely miscible, but on account of the dimorphism of barium chloride, the regular β-mixed crystals first separating change into a doubly refracting α-form. The course of the transition curve was determined. The ternary diagram is divided into areas of complete and incomplete miscibility by a limiting curve. In the area of incomplete miscibility is a ternary eutectic point where the double salt $CaCl_2,BaCl_2$ is in equilibrium with two ternary mixed crystal phases, rich in barium chloride and calcium chloride respectively. The ternary mixed crystals separating in the area of complete miscibility are dimorphous, and the transition surface for these mixed crystals was determined in the same way as the transition curve for the barium-strontium chloride mixed crystals. In the ternary area the existence of the binary compound $CaCl_2,BaCl_2$, crystallising at 631°, and of a ternary compound, $CaCl_2,SrCl_2,BaCl_2$, crystallising at about 500°, was established. These are the only compounds known among the chlorides of the alkaline earths. E. H. R.

Ternary Systems of Potassium Chloride, Sodium Chloride, and the Chlorides of Bivalent Metals. KURT SCHOLICH (*Jahrb. Min.*, 1920, *Beil. Bd.*, **43**, 251—294).—The equilibrium conditions in the three ternary systems formed by sodium and potassium chlorides with calcium, strontium, and magnesium chloride respectively have been investigated.

I. *The System* $CaCl_2$–KCl–NaCl.—The binary system $CaCl_2$–KCl and $CaCl_2$–NaCl were investigated by Menge (A., 1911, ii, 982), who reported the existence of compounds $KCl,CaCl_2$ and $4NaCl,CaCl_2$. Neither Lamplough (A., 1911, ii, 581) nor the present author confirms the existence of the sodium chloride compound. Sodium and calcium chlorides are practically immiscible and form a eutectic at 506° with 53 mols. % $CaCl_2$. The concentration-temperature prism of the ternary system consists of three saturation surfaces, corresponding with the separation of calcium chloride, the double salt $KCl,CaCl_2$, and mixed crystals (K,Na)Cl respectively. The double salt is immiscible with sodium chloride, and forms no compound with it. Through the double salt, the ternary system is divided into two partial systems. In the first of these there is a eutectic point in which calcium chloride, sodium chloride, and double salt are in stable equilibrium. In the second partial system, $KCl,CaCl_2$–NaCl–KCl, there is a limiting curve along which double salt and mixed crystals, (K,Na)Cl, are in equilibrium with the liquid phase. This curve reaches a minimum, where it is met by a curve crossing the mixed crystal surface from the minimum point of the binary NaCl–KCl system.

II. *The System* $SrCl_2$–KCl–NaCl.—Two compounds are formed between strontium chloride and calcium chloride, $2KCl,SrCl_2$, *E*, and $KCl,2SrCl_2$, *D*. The first compound, *E*, forms long, rhombic prisms, and has the melting point 597°; the second, *D*, has m. p.

638°, and is probably monoclinic. The compound *D* forms with sodium chloride a binary eutectic system, by which the ternary system is divided into two partial systems. The ternary diagram is very similar to the previous one, with four surfaces instead of three.

III. *The System* $MgCl_2$–KCl–NaCl.—Magnesium chloride and potassium chloride form only one compound, KCl,$MgCl_2$, the existence of the other compound reported by Menge (*loc. cit.*) not being confirmed. The compound has m p. 487°, and crystallises in large prisms with weak double refraction It forms with sodium chloride a binary eutectic system. Sodium chloride and magnesium chloride form two compounds, the first having the formula NaCl,$MgCl_2$, and the second probably 2NaCl,$MgCl_2$, but the evidence for the latter is indirect. The ternary system is divided into two partial systems by the binary system KCl,$MgCl_2$–NaCl. In the first partial system, $MgCl_2$–NaCl–KCl,$MgCl_2$, are five surfaces, with three invariant points two of which are transition points and the other a eutectic. The other partial system, KCl,$MgCl_2$–KCl–NaCl, is of interest in that the eutectic mixture consists of the double salt KCl,$MgCl_2$ and two limiting mixed crystal phases of NaCl and KCl. The temperature of separation of mixed crystals of sodium and potassium chlorides is raised in presence of a third substance, through the formation of a ternary mixture. In the magnesium chloride ternary mixture the separation of the mixed crystals takes place before the end of the crystallisation process, but in the other cases, in which it was not detected, probably only after solidification is complete.

[Compare Vortisch and Jänecke, this vol , ii, 95, 96]

E H R

System Cupric Oxide, Cuprous Oxide, Oxygen. F. Hastings Smyth and Howard S. Roberts (*J. Amer. Chem. Soc.*, 1920, **42**, 2582—2607).—Cuprous oxide does not form solid solutions in cupric oxide over the temperature range where both oxides remain solid. Previous results (Wöhler, A., 1907, ii, 33) indicating such solutions may probably be explained by lack of careful temperature control, and by possible adsorption of nitrogen in solid cupric oxide giving high initial pressures. The pressure–temperature equilibrium curves for the system CuO–Cu_2O–O_2 have been established over the range in which the oxides remain solid, below the eutectic point, and above the eutectic point, where cupric oxide remains the solid phase up to 1233°. The pressure and temperature of the quadruple (eutectic) point for the system have been established from the intersection of these curves. The quadruple point lies at 1080·2° and 390 mm. pressure. The general direction of the equilibrium curve has been indicated for the system when cuprous oxide remains the only solid phase, and it has been proved that, in accordance with theory, the equilibrium pressure drops in this case with rise in temperature. Pure cupric oxide does not melt with dissociation below 1233°. J. F. S.

Statistical Mechanics Applied to Chemical Kinetics. RICHARD C. TOLMAN (*J. Amer. Chem. Soc.*, 1920, **42**, 2506—2528). —A mathematical paper in which, following the point of view of Perrin, the principles of statistical mechanics are applied to the rate of reactions in gaseous systems. It is assumed in all cases considered that the reactions proceed at a slow, measurable rate, and that they are simple, of the form $aA + bB \longrightarrow$ *products*, there being no steps, and that the mixtures are so dilute that the gas laws may be held to apply. The points treated are: (i) thermal rate of an unimolecular reaction, (ii) temperature-coefficient of the velocity of a unimolecular reaction, (iii) photochemical rate of a unimolecular reaction, (iv) temperature-coefficient of the velocity of unimolecular photochemical reactions, and (v) di- and polymolecular reactions. J. F. S.

Oxidation Pressure Limits. II. The Pressure Limit of Autoxidation considered as a Particular Case of the Inferior Limit of Explosion. W. P. JORISSEN (*Rec. trav. chim.*, 1920, **39**, 715—719. Compare A., 1919, ii, 62).—The author has examined the influence of carbon dioxide on the pressure limit of phosphorescence of phosphorus and on the inferior limits of explosion of hydrogen and methane. In each case the influence of carbon dioxide is greater than that of nitrogen. Similarly, he has determined the inferior limit of explosion for acetaldehyde and its displacement by carbon dioxide. W. G.

Effect of Oxygen on the Limits of Inflammability of Inflammable Gases and Vapours. E. TERRES (*J. Gasbeleucht*, 1920, **63**, 785—792, 805—811, 820—825, 836—840).—The determinations were made in a Bunte burette 19 mm. in diameter and 115—120 c.c. in capacity. Mixtures were ignited from above, and an analysis was carried out to see whether the flame had passed through the whole of the mixture. The limits were determined in air, in oxygen, and in atmospheres intermediate in composition between air and oxygen. In all cases, the lower limit differed only slightly in air and in oxygen, but the upper limit was always very much higher in pure oxygen. The results obtained in air and in oxygen were as follows. In air: carbon monoxide, 15·6—70·9; hydrogen, 9·5—65·2; water gas, 12·4—66·1; coal gas, 9·8—24·8; methane, 6·3—11·9; ethane, 4·2—9·5; ethylene, 4·0—14·0; acetylene, 3·5—52·3; light petroleum vapour, 2·1—5·0; benzene, 2·8—6·8. In oxygen: carbon monoxide, 16·7—93·5; hydrogen, 9·2—91·6; water gas, 12·6—92·0; coal gas, 10·0—73·6; methane, 6·5—51·9; ethane, 4·1—45·8; ethylene, 4·1—61·8; acetylene, 3·5—89·4; light petroleum vapour, 2·1—28·4; benzene, 2·8—29·9. W. P.

The Influence of the Solvent on the Temperature-coefficient of certain Reactions. A Test of the Radiation Hypothesis. HENRY EDWARD COX (T., 1921, **119**, 142—158).

Mutual Reaction of Oxalic Acid and Iodic Acid: Influence of Temperature and Dilution. GEORGES LEMOINE (*Compt. rend.*, 1920, **171**, 1094—1100).—At low temperatures and high dilutions, the decomposition of iodic acid in solution by oxalic acid, with the consequent liberation of iodine and carbon dioxide, progresses extremely slowly. The velocity of reaction increases rapidly with rise in temperature or with increase in concentration of the reagents. In all cases, there is a slight retardation at the commencement of the reaction, until the solution becomes saturated with iodine. If the solution is previously saturated with iodine, this retardation is not noticed. W. G.

Some Properties of Explosives. A Lecture delivered before the Chemical Society on December 16th, 1920. SIR ROBERT ROBERTSON (T., 1921, **119**, 1—29).

The Thermal Decomposition of Acetylene in Contact with Metallic Catalysts. E. TIEDE and W. JENISCH (*Brennstoff-Chem.*, 1920, **2**, 5—8).—Acetylene was passed at the rate of 4 litres per hour over different metallic catalysts placed in small porcelain boats inside a tube of Jena-glass, 1·4 cm. in diameter and 40 cm. long, electrically heated at temperatures up to 600°. Liquid products were collected by freezing and solution in paraffin, and estimated by weight, whilst samples of the residual gases were analysed. Two sets of metals are distinguished, "active" and "inactive." The presence of an inactive element had no effect on the temperature of decomposition, and little difference in the percentage decomposition was noticed, whether the boat was empty or contained one of these metals. At 440°, the first grey mist was formed, indicating the commencement of polymerisation, the first drops of oil beginning to collect at 540°. At 600°, the residual gases contained, on an average, 90% of unaltered acetylene. The inert elements used were Al, Sb, Pb, B, Cd, Ca, Cr, Au, C, Mg, Mo, Ag, Si, Ta, Tl, Ti, U, Bi, W, Zn, Sn, and Zr, also Pd and Pt in compact form. With the active metals, the separation of carbon and the formation of the first drops of oil, respectively, commenced at the following temperatures, and the percentage of unaltered acetylene in the residual gases (temperature of tube, 600°) were as given: Fe, 400°, 540°, trace; Co, 380°, 480°, 17·2%; Ni, 360°, 520°, 20·2%; Cu, 310°, 310°, 23·5%; Mn, 450°, 480°, 8·7%. Their action is probably due to the readiness with which these metals form carbides. Alloys were also tried. Cu–Au, Cu–Sn, Cu–Al are classed as inactive, whilst Cu–Ni was active. Finely divided Pt was also active. W. P.

Preparation of Active Hydrogenating Metals. A. BROCHET (*Bull. Soc. chim.*, 1920, [iv], **27**, 897—898).—An activated nickel may readily be prepared by heating certain of its organic salts, such as the formate or the oxalate. In the case of the formate, the decomposition is marked at 200—250°, and very rapid at 270°.

The oxalate requires a temperature of 320—380°. The nickel so obtained is not spontaneously pyrophoric at the ordinary temperature in contact with air. Cobalt and iron behave in the same manner as nickel in this method of preparation. During the decomposition of the formate by heat, there is absorption by the nickel of a small amount of the carbon dioxide produced during the decomposition. W. G.

The Preparation of Active Hydrogenating Metals in Liquid Media. A. Brochet (*Bull. Soc. chim.*, 1920, [iv], **27**, 899—901. Compare preceding abstract).—If nickel formate is heated in cotton oil at temperatures below 150°, no change occurs, but from 160—270° the formate is decomposed and the oil undergoes partial hydrogenation. The nickel is left in an active state, and will cause the complete hydrogenation of such oil at 100° under pressure in an atmosphere of hydrogen. W. G.

The Rôle of Protective Colloids in Catalysis. I. Thomas Iredale (T., 1921, **119**, 109—115).

Hypotheses on the Unity of Matter. C. de Marignac (*J. Chim. Phys.*, 1920, **18**, 261—269).—A theoretical paper in which it is shown that there is nothing improbable in the hypothesis of the unity of matter, but the idea will probably always remain a purely theoretical conception. Weight is the most fundamental property of matter, and probably the only property which belongs essentially to the ultimate particles of primordial matter. Specific heat and electricity are properties of the second order which only show themselves in those groups of material particles which constitute the chemical atoms, whilst volume is a property which is determined by more or less complex groups of atoms which constitute the molecules of chemical substances. J. F. S.

Is the Existence of Atoms and Molecules Demonstrated? A. von Antropoff (*Zeitsch. angew. Chem.*, 1920, **33**, 321—324).—The question of the real existence of atoms and molecules is complicated by purely philosophical difficulties unless stated in an appropriate manner. Older and newer proofs of the existence of atoms are considered not to be convincing, but a more exact demonstration may be found in canal rays, which exhibit scintillations on a zinc sulphide screen. J. R. P.

Harmony of the Atomic Weights and Mathematics. D. Droste (*Pharm. Zeit.*, 1920, **65**, 822—823, 1017—1018).—The relations discovered by Schmiz (A., 1919, ii, 460) are purely mathematical and are not peculiar to atomic weights. J. R. P.

Harmony of Atomic Weights. Ed. Schmiz (*Pharm. Zeit.*, 1920, **65**, 945).—Reply to Droste (see preceding abstract), and further speculations on the structure of atoms. J. R. P.

Is H composed of a Whole-number Part (*A*) plus an Auxiliary Part (*B*) and a Rotating Electron (*C*)? F. H. LORING (*Chem. News*, 1920, **121**, 315—318).—Hydrogen appears to be unique in not having a whole-number atom. The fractional part of its mass is relatively great. Hydrogen does not find its place properly at the heads of Groups I and VII. Its chemical activity is evidently not such as to enable it to form stable polymerides answering to known elements. There is a gap at the end of Group I that does not accommodate any radioactive element. Similarly, there are gaps below manganese which seem difficult to fill, and one of these would have to be filled by a radioactive element, which seems improbable. On the hypothesis that all elements are polymerides of hydrogen, a difficulty arises owing to the fractional value, suggesting that the fundamental unit has a mass of 1 exactly. Considering hydrogen as a complex atom composed of mass parts, $a=1\cdot000$, $b=0\cdot0077$, and c (an electron)$=0\cdot00055$, the parts a and b could possibly more properly be placed at the heads of Groups I and VII respectively, thus accounting for the very strong affinity between these parts and the great stability of the hydrogen complex ab. The separate parts alone might have very great affinities, especially a, which could polymerise and form the whole-number atoms. The atomic numbers of b and a might be 0 and 1, or 2 and 7. Small multiples of b might also be attached to other elements and account for irregularities in the Periodic Table. J. R. P.

The Mendeléev Series arranged and brought up to date in 1917, according to the latest published Atomic Weights. G. BOURGEREL (*Mon. Sci.*, 1920, [v], **10**, 241—242).—Jandrier (A., 1920, ii, 747) considered that there were still two unknown elements to appear in Mendeléev's series having atomic weights about 152 and 216 respectively. The present author claims to have discovered two such metals in certain minerals, and he names them ekarhodium and ekaerbium respectively. Ekarhodium gives a non-volatile chloride, which is decomposed by heat, losing chlorine. Its oxide gives salts with the alkali hydroxides.

Ekaerbium was obtained as its hydroxide, which, when calcined, gives an oxide insoluble in acids. Its hydroxide dissolves in hydrochloric acid, and on diluting the solution with water a flocculent precipitate is obtained. From the hydrochloric acid solution a black precipitate is obtained on the addition of ammonium sulphide, and the precipitated sulphide, on ignition, is converted into the oxide, which apparently has the formula E_2O_3, as, on reduction in hydrogen at 1000—1100°, it loses 3·40% of its weight. W. G.

New Periodic Classification of the Elements. GIUSEPPE ODDO (*Gazzetta*, 1920, **50**, ii, 213—245).—After referring to some of the artificialities and anomalies of the Mendeléev system, the author describes his own method of classifying the elements, this being based on the following principles. Hydrogen is placed first, lithium beneath it, and the rest of the elements in order of their

atomic weights, a new period being commenced when a pronouncedly metallic element is followed by a decidedly non-metallic element; the position of the latter, with which the new period begins, is chosen so that neon comes under helium. According to this arrangement, the non-metals form five vertical groups and are separated by the zerovalent elements from the metals, which make up eighteen vertical groups. The elements in the zerovalent vertical group are indicated by asterisks.

The eight horizontal periods comprise the following elements: (I), H alone; (II), He*, Li, Ge; (III), B, C, N, O, F, Ne*, Na, Mg, Al; (IV), Si, P, S, Cl, A*, K, Ca, Sc, Ti, V, Cr, Mn, Fe, Ni, Co, Cu, Zn, Ga, Ge; (V), As, Se, Br, Kr*, Rb, Sr, Yt, Zr, Nb, Mo, —, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb; (VI), Te, I, X*, Cs, Ba, La, Ce, Pr, Nd, Sa, Eu, —, Gd, Tb, Dy, —, Er, Tu; (VII), —*, Yb, —, Lu, —, Ta, W, —, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, [Th-D, Ra-D, -E, -F=Po, AcD], [Th-B, -C_1, -C_2, Ra-B, -C_1, -C_2, AcB and C], [Th-A, Ra-A, Ac-A]; (VIII), [Em-Th, Em-Ra, Em-Ac]*, [Th, Ra, Ac], [M-Th 1 and 2, Ra-Th, Ux, Uy and Io, Ra-Ac, and Ac], [Th, U_2], U.

The advantages of this system in bringing out both the physical and chemical analogies, not only among the groups, but also among the periods, are discussed. T. H. P.

Periodic Classification of the Elements. J. R. PARTINGTON (*Chem. News*, 1920, **121**, 304).—A spiral representation of the periodic system, similar to that of Nodder (this vol., ii, 38), but showing radioactive changes, isotopes, and the Fajan's rule, is described. J. R. P.

Periodic System of the Elements from the Point of View of the Theory of Radioactive Disintegration. F. KIRCHHOF (*Physikal. Zeitsch.*, 1920, **21**, 711—718).—A theoretical paper in which the considerations previously published (A., 1920, ii, 611) are further developed. It is shown that the atomic weights of the elements may be calculated by means of the formula $A=2(M+I)^2$, in which M is the atomic number and I the isotope number. It is shown that the anomalous atomic weights of the pairs of elements, argon–potassium; cobalt–nickel; tellurium–iodine, are to be explained by the fact that the element first named has a larger isotope number than the second, and since the isotope number depends, in part, on the relative period of existence of the isotopes, it follows that in the first-named element the isotope with largest atomic weight has the longest life, and consequently the atomic weight of the isotope mixture is correspondingly larger, whilst in the case of the second element the isotope with the smaller atomic weight has a longer life than the corresponding isotope of the first-named element; consequently, the atomic weight of the second element is smaller, and so the anomaly comes into being. On plotting curves of the isotope number against the atomic number of the elements with even atomic number in one curve and those of odd atomic number in another curve, it is found that up to germanium the

curve of the even elements lies below the odd elements, thereafter up to molybdenum the two curves run side by side and very close together, and beyond molybdenum the curve of the even elements lies above that of the odd elements. The author shows that many even elements show a very close analogy to the next odd element. A list of such pairs is given, and a discussion is entered into as to their origin. An arrangement of the periodic system is put forward which in many respects is similar to that put forward by Crookes and by Soddy. J. F. S.

Standardisation of Weights. A. J. HOPKINS, J. B. ZINN, and HARRIET ROGERS (*J. Amer. Chem. Soc.*, 1920, **42**, 2528—2531).—A method is described, which is a slight modification of that published by Richards (A., 1900, ii, 534), for redistributing the error accumulated in a set of calibration weighings over the whole of the weights concerned, and not allowing it all to fall on the heaviest weight employed. The method makes use of a box of standards, 100 mg., 1, 5, 50, and 500 grams. J. F. S.

Modified Soxhlet Extraction Apparatus. OSKAR HAGEN (*Chem. Zeit.*, 1921, **45**, 19).—The ordinary siphon tube of the Soxhlet apparatus is dispensed with, and the stem of the apparatus is bent into a ring-shaped trap, which is provided with a two-way tap. The condensed solvent falls from the condenser into a thimble containing the substance to be extracted, and fitted in the cylindrical part of the apparatus, and then passes down the stem, through the tap, and into the extraction flask. By turning the tap, the solvent may be drawn off from the ring-shaped trap as desired. W. P. S.

Sulphuric Acid Concentrator and Vacuum Pump. O. MAASS (*J. Amer. Chem. Soc.*, 1920, **42**, 2571—2574).—The apparatus described is useful for concentrating solutions under reduced pressure. It has the advantage over a mercury pump that the vapours removed from the solution are absorbed by the sulphuric acid, and so the vacuum is kept down to the vapour pressure of sulphuric acid, and not to that of the liquid evaporating. The liquid to be concentrated is placed in bulbs, which are connected to a large, cylindrical vessel filled with glass tubes, below which is placed the sulphuric acid reservoir. The apparatus is exhausted to the point to which a Geissler pump will take it, and then the sulphuric acid is forced into the evacuated cylindrical vessel by an automatic control (A., 1919, ii, 104), which has the effect of absorbing vapours, forcing the non-absorbable gases from the apparatus, and moistening the glass rods in the cylindrical vessel with sulphuric acid. The control then withdraws the sulphuric acid into the reservoir, which improves the vacuum. This process then goes on repeatedly until the evaporation or concentration is completed. J. F. S.

Device for Preventing Back-flow of Water from Water-pumps. HANS DORSCH (*Chem. Zeit.*, 1921, **45**, 32).—The handle of a glass tap is fixed rigidly in a clamp so that the tubes on either side of the tap are in a horizontal position when the tap is open; the tube on one side of the tap is connected by a piece of rubber pressure-tubing with the vessel from which the air is to be exhausted, whilst the tube on the other side of the tap is bent slightly downwards and passed through a rubber stopper closing a flask. A second tube passes through the stopper and reaches to the bottom of the flask, the outer end of this tube being connected by a piece of rubber tubing to the water-pump. If the water pressure decreases, water flowing back from the pump enters the flask, and the additional weight causes the flask to descend, thereby closing the tap; when the water pressure increases, water is drawn from the flask, the latter rises, and the tap is opened, thus placing the pump once more in connexion with the vessel. W. P. S.

Expulsion of a Gas from its Solution by Changing its Solvent. S. GENELIN (*Zeitsch. physikal. Chem. Unterr.*, 1920, **33**, 147).—Ethyl chloride gas, generated by dropping warm water into a small amount of ethyl chloride, may be conducted into alcohol until the evolution of bubbles indicates a saturated solution. By shaking the alcoholic solution with much water, the insolubility of the gas in water is indicated by the evolution of gas bubbles. CHEMICAL ABSTRACTS.

The Preparation of Nitrogen Peroxide from Air with the Spark from a Weak Induction Coil. S. GENELIN (*Zeitsch. physikal. Chem. Unterr.*, 1920, **33**, 146—147).—The spark from a weak induction coil, if discharged from platinum electrodes 1—2 mm. apart in a eudiometer tube standing vertically with open end up, will generate sufficient nitrogen peroxide to be recognisable by colour in half an hour, provided the air in the tube is previously well dried by sulphuric acid for twenty-four hours. The gaseous contents of the tube, if dissolved by shaking with a very little water, will give the test for nitrous acid. CHEMICAL ABSTRACTS.

The Ignition of Phosphorus under a Bell Jar standing over Water. H. REBENSTORFF (*Zeitsch. physikal. Chem. Unterr.*, 1920, **33**, 18—20).—Small pieces of phosphorus are placed in a porcelain dish floating on water under a bell jar. The stopper of the bell jar carries a glass tube sealed at the upper end and containing tin which has been melted together after being placed in the tube in the form of fine granules; at the lower end, a tube of diameter large enough to slip over the first is fastened by a wire or cord so that the length of the tube is adjustable. After placing the tube so that it rests directly over the phosphorus, the upper part of it is heated until a drop of the hot tin falls on the phosphorus and ignites it. CHEMICAL ABSTRACTS.

Inorganic Chemistry.

Properties of Pure Hydrogen Peroxide. I. O. MAASS and W. H. HATCHER (*J. Amer. Chem. Soc.*, 1920, **42**, 2548—2569).—Pure hydrogen peroxide is obtained as follows: 3% hydrogen peroxide, obtained from barium peroxide, is concentrated to 30% by means of a sulphuric acid concentrator (Maass, this vol., ii, 104). It is then distilled at very low pressure to remove the non-volatile impurities. A self-acting sulphuric acid pump is used at this stage to keep the pressure down. A further concentration by the sulphuric acid concentrator at 0° raises the concentration to 90%, but above this point it is not possible to go, because of the high vapour tension of the peroxide. The final product, 100% hydrogen peroxide, was obtained by fractional solidification and melting. Adopting this method, and using all the precautions noted by the authors, a yield of 50% of pure hydrogen peroxide may be obtained from the 3% solution. The pure material is found to have the following physical properties: m. p. −1·70°, whilst a 96·7% solution melts at −4·00; density of liquid, at −12·13°, 1·4774; −6·23°, 1·4705; −0·53°, 1·4638; 1·20°, 1·4617; 5·55°, 1·4570; 8·30°, 1·4541; 12·60°, 1·4490; 15·30°, 1·4465; and 19·90°, 1·4419; density of solid, −4·45°, 1·6434; −7·45°, 1·6437; viscosity, 0·04°, 0·01828; 11·90°, 0·01456; 12·20°, 0·01447; 19·60°, 0·01272; surface tension, 0·2°, 78·73; 6·2°, 77·79; 11·0°, 77·51; 13·9°, 76·47; and 18·2°, 75·94 dynes; association factor, 3·48; specific heat of liquid, 0—18·5°, 0·5730; −32·0—18·0°, 0·5697; specific heat of solid, −9·0—17·87°, 0·4701; latent heat of fusion, 73·91 cal.; refractive index (*D*), 22°, 1·4140; molecular refractive power, 5·900. Hydrogen peroxide is very slightly soluble in ether, it dissolves many normal salts readily, and attacks glass. Pure hydrogen peroxide explodes violently when a piece of sodium is added; it whitens, but does not permanently destroy, living skin; it does not decompose when kept at 0°. J. F. S.

Properties of Pure Hydrogen Peroxide. II. O. MAASS and O. W. HERZBERG (*J. Amer. Chem. Soc.*, 1920, **42**, 2569—2570. Compare preceding abstract).—The freezing-point curve of mixtures of hydrogen peroxide and water has been determined for the whole range of concentration. It is shown that only one compound, $H_2O_2,2H_2O$, exists; this has a melting point −51°, and corresponds with 48·6% of hydrogen peroxide. J. F. S.

Molecular State of Water Vapour. JAMES KENDALL (*J. Amer. Chem. Soc.*, 1920, **42**, 2477—2482).—A theoretical paper in which the contradictory conclusions of Bose (A., 1908, ii, 577) and Oddo (A., 1915, ii, 683) with regard to the molecular state of water vapour are discussed, in view of the fact that the unimole-

cular nature of this substance has been questioned, the existence of double molecules at high temperatures and of spontaneous ionisation at low temperatures being assumed. It is shown that the evidence in support of the equilibria $H_2O \rightleftarrows H^{\cdot} + OH'$ and $2H_2O \rightleftarrows (H_2O)_2$ is in each case entirely insufficient, and that the abnormalities in the vapour densities of normal substances at their boiling points are similar to that in water vapour at 100°. Such abnormalities practically vanish on applying the corrections for deviations from the perfect gas laws. An equation of state correction is similarly necessary in gas reactions at high pressures, in calculations on dissociation in the vapour state, and in Dumas or Victor Meyer vapour-density determinations. J. F. S.

The Purification of Air Containing certain Toxic Gases. A. Desgrez, Guillemard, and Savès (*Compt. rend.*, 1920, **171**, 1177—1179; *Chim. et Ind.*, 1920, **4**, 514—517).—For the removal of chlorine at a concentration of 1 in 2000, a solution of 220 grams of sodium thiosulphate and 175 grams of sodium carbonate in 1000 c.c. of water is sprayed in with a Vermorel sprayer. For a mixture of carbonyl chloride and chlorine a 12% solution of sodium carbonate is the best spray fluid. A fluid containing 240 grams of sodium polysulphide and 140 c.c. of soap boilers' lye in 1 litre is efficient for removing chlorine, carbonyl chloride, chloromethyl chloroformates, acraldehyde, bromoacetone, cyanogen chloride, chloropicrin, and benzyl chloride, bromide, or iodide. W. G.

History of the Knowledge of Combustion. Edmund O. von Lippmann (*Zeitsch. angew. Chem.*, 1920, **33**, 301).—A bibliographical résumé of the knowledge of combustion in ancient and mediæval times. W. P. S.

The Mechanism of some Combustions. H. von Wartenberg and B. Sieg (*Ber.*, 1920, **53**, [*B*], 2192—2202).—The correctness of the assumption that reaction between two substances is preceded by the formation of an unstable additive compound is now proved in the case of certain combustions.

Carbon monoxide, for example, must be moist before it will react with oxygen at ordinary flame temperatures. The amount of water necessary to promote explosion of the ideal mixture is just the same, whether the oxygen is provided as oxygen gas or as nitrous oxide, and is approximately that quantity which corresponds with a partial pressure of 0·5 mm. Moreover, the presence of hydrogen may be demonstrated in a carbon monoxide flame, which, in addition to Wieland's proof of the production of formic acid (A., 1912, ii, 347), completely supports Dixon's theory of the mechanism of the combustion (T., 1886, **49**, 94), thus: (1) $CO + H_2O = H \cdot CO_2H$; (2) $H \cdot CO_2H = CO_2 + H_2$; (3) $H_2 + O_2 = H_2O_2$; (4) $H_2O_2 = H_2O + O$. In the experiments to prove the first reaction, the explosive gases were allowed to stream from a water-gasometer, through a coil immersed in a Dewar vessel, then through a short tube packed with

brass filings to prevent back-fire, and into a tube provided with platinum wires to give a spark about 1 cm. long. After drying the apparatus at 300—400° by means of air circulated over phosphoric oxide, alcohol and solid carbon dioxide were placed in the Dewar vessel, and the temperature was gradually allowed to rise until the gases were moist enough to explode. Explosion took place at about −23°. The sparks must be regular in order to get comparative results, for combination, of course, takes place at every spark, and whether the explosion is propagated throughout the gas or not depends on the amount of heat developed. In an experiment in which the explosion-chamber was heated at one spot by a blowpipe flame, the gases reacted over the hot surface even when the temperature of the drying coil was −80°, giving a flame which slowly wandered into the colder parts and was soon extinguished. The presence of hydrogen in a carbon monoxide flame was demonstrated by burning the gas in a Bunsen burner with quartz tube and holding in the flame a platinum tube attached to an exhausted mercury manometer. A fall in the column of mercury indicated diffusion of hydrogen into the platinum tube, and was only observed if the carbon monoxide or air supplies were moist.

The combustion of hydrogen proceeds *via* the formation of hydrogen peroxide. It appeared that this might be demonstrated by preventing the explosion of hydrogen and oxygen mixtures by substances unfavourable to the formation of hydrogen peroxide. The mixtures were therefore passed through various liquids, warmed to such temperatures that the vapour carried forward was sufficient to prevent explosion. The necessary partial pressures in % of the total pressure are as follows: CH_2O, 68; CS_2, 84·2; HCl, 65·5; NH_3, 63·4; SO_2, 58·3; HCN, 59·3; MeOH, 52·0; H_2S, 50·0; Me·CHO, 35·5; Et_2O, 33·4; EtCl, 31·9; EtSH, 30·5; Me_2O, 29·6; $EtNH_2$, 27·7; Pr_2O, 25·4; Me_2CO, 21·3; C_6H_{14}, 19·7; $MeCO_2Et$, 17·3; C_7H_8, 13·1; Me_3N, 14·2; C_6H_6, 13·6. Obviously, these results throw no light on the point in question, for it is scarcely conceivable that benzene should be so much more effective than formaldehyde. The formation of hydrogen peroxide was approximately determined quantitatively by passing a mixture of oxygen and hydrogen in the ratio 9:1 through a quartz tube narrowed to a capillary, part of which was heated and the remainder cooled, and allowing the products to collect in a weighed receiver in a freezing mixture. The rate of flow of the gases, the temperature, the weight of water and hydrogen peroxide (permanganate titration) formed, and the amount of ozone in the issuing gases (iodine titration) were determined. Using oxygen and water vapour only, no hydrogen peroxide and very little ozone could be found, whereas the amount of hydrogen peroxide obtained by burning hydrogen and oxygen was about one million times as great as that demanded from the equation $H_2O + \frac{1}{2}O_2 \rightleftharpoons H_2O_2$, and, moreover, decreased, instead of increased, with rise of temperature. It appears, therefore, that the union of hydrogen and oxygen at 600—1000° so proceeds that hydrogen peroxide is first formed in considerable concentration, then quickly

decomposes into water and oxygen, atoms of the latter uniting to a certain extent to form ozone, which decomposes more slowly than hydrogen peroxide and is found in greater concentrations.

A hint of the production of a peroxide-like substance was also obtained in the case of cyanogen, and the combustion of methane (Bone and Wheeler, T., 1902, **81**, 535) may be interpreted in a similar manner. J. C. W.

Simple Form of Kipp's Apparatus for the Generation of Hydrogen Sulphide. V. B. CONNELL (*Pharm. J.*, 1921, **106**, 17).—A wide-mouthed bottle is closed with a rubber stopper through which pass a delivery tube and a vertical tube reaching to the bottom of the bottle; the end of the delivery tube is fitted with a length of rubber tubing and a spring clip. The outer end of the vertical tube extends just through a rubber stopper closing a second similar bottle which is placed in an inverted position over the first. The ferrous sulphide is placed in the first bottle, and the inverted bottle serves as a reservoir for the acid when the apparatus is not in use. A bent tube, extending to the top of the inverted bottle, allows air to enter or escape according to the change in level of the acid. W. P. S.

Trithiocarbonates and Perthiocarbonates. ERNEST WICKHAM YEOMAN (T., 1921, **119**, 38—54).

Preparation of Selenium Oxychloride. VICTOR LENHER (*J. Amer. Chem. Soc.*, 1920, **42**, 2498—2500).—A number of methods are described for the preparation of selenium oxychloride, selenium monochloride, and selenium tetrachloride. Selenium monochloride is prepared by suspending powdered selenium or powdered minerals containing selenium in carbon tetrachloride saturated with chlorine. The selenium is converted into the monochloride in the cold, and dissolves in the carbon tetrachloride, whilst the chlorides of other elements present are insoluble. The monochloride is therefore obtained by filtration and distillation of the carbon tetrachloride.

Selenium tetrachloride is prepared by saturating a cold solution of the monochloride in carbon tetrachloride or chloroform with chlorine. The tetrachloride is insoluble, and precipitates as rapidly as it is formed as a white powder.

Selenium oxychloride is prepared by adding dry selenium dioxide to a suspension of selenium tetrachloride in carbon tetrachloride. Reaction takes place in the cold, and the oxychloride dissolves in the carbon tetrachloride, from which it may be obtained by distillation, b. p. 176·4°. A perfectly pure product is obtained by fractionation under slightly reduced pressure. The oxychloride can also be obtained by adding the theoretical quantity of water to a suspension of the tetrachloride in carbon tetrachloride, according to the equation $SeCl_4 + H_2O \longrightarrow SeOCl_2 + 2HCl$. It may also be prepared from the compound $SeO_2,2HCl$. This substance is obtained by

treating selenium dioxide with dry hydrogen chloride at low temperatures when an amber-coloured liquid is formed. On mixing this liquid with phosphoric oxide or calcium chloride and distilling, the oxychloride passes off. The reaction may also be effected by mixing selenium dioxide with the dehydrating agent and passing in hydrogen chloride in the cold and then distilling off the oxychloride.

J. F. S.

The Sub-iodide of Tellurium, TeI_2. The System Iodine-Tellurium. A. DAMIENS (*Compt. rend.*, 1920, **171**, 1140—1143).—From a thermal study of mixtures of tellurium and iodine in varying proportions it is shown that the so-called tellurium sub-iodide, TeI_2, is not a definite compound, but is a mixture of two substances, namely, the tetraiodide and a solid solution of tellurium and the tetraiodide. The product, having the composition TeI_2, when melted and allowed to cool, deposits first of all the tetraiodide at 215°, and on further cooling the eutectic mixture begins to deposit at 170·3° and continues until complete solidification is reached. The curve only indicates one definite compound, the tetraiodide, TeI_4.

W. G.

Preparation of Hydrogen Triarsenide of High Percentage Purity, and its Estimation. H. THOMS and L. HESS (*Ber. Deut. Pharm. Ges.*, 1920, **30**, 483—489).—Pure hydrogen triarsenide is conveniently obtained by the action of water or acids on calcium arsenide (compare Lebeau, A., 1899, ii, 288). The difficulty and danger of preparing the latter substance can be entirely obviated by adding a neutral diluent, such as sand (5·5 kilo.) to the mixture of powdered arsenic (3·1 kilo.) and coarse calcium filings (2·4 kilo.). This mixture is placed in a container made of sheet iron, bolted together in such a way that it can be entirely opened up at the end of the experiment to remove the solid cake of arsenide. The container is placed within a second vessel with an air-tight cover, which during the combustion is replaced by an asbestos cover with a hole in the centre. The combustion is started by means of a magnesium–potassium chlorate mixture, and slowly extends throughout the entire mass, giving rise to an intense glow, but no flame and formation of but little arsenious oxide. When cold, the arsenide is removed and ground to a coarse powder, and may be then used, instead of sand, in the same proportion, as diluent in succeeding preparations. The evaluation of calcium arsenide by estimation of the hydrogen arsenide evolved on treatment with water is carried out in a brine-charged nitrometer connected at the top with a stoppered bulb absorption vessel containing copper chloride solution, and at the base with a closed decomposition vessel, also filled with brine and containing a weighed quantity of the arsenide in a small weighing bottle closed with a rubber stopper. When all air has been removed the stopper is knocked out of the weighing bottle, and the hydrogen arsenide and hydrogen evolved collected in the nitrometer. The percentage

of hydrogen arsenide in the gas is estimated by passing it into the copper chloride absorption bulb and shaking vigorously, the residual hydrogen being passed back into the nitrometer and measured. Calcium arsenide prepared as above described gives about 37—38% of hydrogen arsenide as compared with 58% theoretically. The remainder of the arsenic appears, probably as solid hydrogen arsenide, as a brown powder in the reaction vessel. The gaseous hydrogen arsenide usually contains about 0·004% by weight or 14% by volume of hydrogen. Aqueous solutions of the gas undergo rapid decomposition, with the formation of arsenic, which remains in colloidal solution. The decomposition can be followed by titration of the solution with $N/100$-iodine. The oxidation occurs in two phases: $AsH_3 + 3I_2 + 3H_2O = H_3AsO_3 + 6HI$, and then, after rendering alkaline with potassium hydrogen carbonate, the usual oxidation to arsenic acid. G. F. M.

Softening of Carbon. JULIUS GMACHL-PAMMER (*Monatsh.*, 1920, **41**, 467—476).—The results of the author's experiments on the softening of carbon when heated show that impurities exert an influence, impure carbon being distinctly, although not considerably, more flexible than the pure element. Graphite rods soften only at a much higher temperature than arc carbons; this observation is confirmed by the fact that protracted heating of arc carbons, which converts the latter into graphite, raises the softening point to a marked extent (compare Plotnikow, *Physikal. Zeitsch.*, 1918, **19**, 520; 1919, **20**, 25). T. H. P.

The Preparation of Artificial Diamonds. F. FISCHER (*Brennstoff-Chem.*, 1921, **2**, 9).—Under pressures which are not abnormally high the separation of carbon in the form of diamond (a non-conductor of electricity) can take place only below 700°; otherwise it appears as graphite (which is a conductor). This explains the small size of the diamonds obtained by Moissan. At 700° the iron containing the carbon in solution had already solidified, so that the carbon could only separate in the form of tiny crystals. Larger diamonds could possibly be obtained by the utilisation of a substance in which carbon was readily soluble, but which would still be molten at 700°. W. P.

The Methods of Investigating the Molecular Condition of Silicate Fusions. H. E. BOEKE (*Jahrb. Min.*, 1914, *Beil. Bd.*, **39**, 64—78).—A review of the methods available for the determination of the molecular weight of fused silicates, and of the work so far published on the subject by different investigators. The methods discussed include those depending on determinations of surface tension, electrical conductivity, diffusion, and depression of freezing point. E. H. R.

Inflammability of Jets of Hydrogen and Inert Gas (Helium). P. G. LEDIG (*J. Ind. Eng. Chem.*, 1920, **12**, 1098—1100).—Experiments were made to determine the maximum

amount of hydrogen which could be used with helium in balloons without losing the advantage of non-inflammability. Under the most favourable conditions, a jet of helium containing more than 14% of hydrogen can be ignited in air, but from 18 to 20% of hydrogen may be mixed with helium without producing a mixture which will burn with a persistent flame when issuing from an orifice under the conditions prevailing in balloon practice. A mixture containing more than 20% of hydrogen cannot be used with safety. W. P. S.

Hydrolysis of the Silicates of Sodium. ROBERT HERMAN BOGUE (*J. Amer. Chem. Soc.*, 1920, **42**, 2575—2582).—The hydrolysis of various silicates of sodium in aqueous solution has been determined by the electrometric measurement of the hydrogen-ion concentration. The results show that if the conclusions reached by earlier investigators, to the effect that dilute solutions of sodium silicate are highly hydrolysed, are to be accepted, then it follows from the present work that the electrometric hydrogen-ion method is unsuitable as a means of measuring such hydrolysis. The reason for this appears to be in a possible ability of the colloidal silica to adsorb or otherwise destroy the effect of a certain proportion of the hydroxyl ions in the solution. The effect of dilution on this adsorptive or retarding influence follows closely the same laws as the effect of dilution on hydrolysis. The hydrogen-ion determination may serve, however, as a measure of the actual alkalinity of the dispersed phase. If the assumptions made in the present paper are entirely justified, then it follows that the hydrolysis of the silicates of sodium is much lower in dilute solutions than has been held to be the case, ranging from 1·58% to 28·43% at a dilution of 100 litres per gram-mol. in the silicates, which vary in their $Na_2O\cdot SiO_2$ ratio from 1:4 to 1:1. Sodium metasilicate is the most highly hydrolysed salt, and the degree of hydrolysis decreases the larger the amount of silica in the silicate. J. F. S.

Carbonates. II. HANS LEITMEIER (*Jahrb. Min.*, 1916, *Beil. Bd.*, **40**, 655—700. Compare A., 1910, ii, 503).—Experiments are recorded on the crystallisation of calcium and magnesium carbonates, in an investigation on the genesis of deposits of these carbonates and of dolomite. In presence of magnesium sulphate, calcium carbonate crystallises at 20° from water saturated with carbon dioxide only in the rhombic form (aragonite); 0·9% of magnesium sulphate in solution is sufficient to inhibit the appearance of calcite. The opinion of Vaubel (A., 1912, ii, 1180) that there is a chemical difference between aragonite and calcite, the former containing hydroxyl in the form of basic carbonate, is shown experimentally to be incorrect.

Solutions saturated with magnesium hydrogen carbonate deposit at the b. p. a basic carbonate, $Mg_4C_3O_{10},6H_2O$, in the form of slender needles. This basic carbonate is deposited alone at temperatures down to 65°, but at 60° it appears mixed with larger prismatic

crystals of the trihydrate, $MgCO_3,3H_2O$. Below 55° the trihydrate alone is formed, down to about 6—10° (compare A., 1910, ii, 49). The pentahydrate, $MgCO_3,5H_2O$, is very unstable at ordinary temperatures, becoming dehydrated to the trihydrate. It is identical with the mineral lansfordite. Many attempts to synthesise crystalline magnesite were made without success. After a long discussion it is concluded that the mineral is probably of marine origin. Amorphous magnesite is formed by the decomposition of magnesium silicates by carbonic acid. Experiments lasting over several months were made on the solubility of serpentine and olivine in water containing varying proportions of carbon dioxide, and it was proved that the minerals are attacked with formation of silica and magnesium carbonate. The latter probably first appears in nature as the trihydrate, and undergoes slow transformation into the amorphous, anhydrous form. Numerous attempts were made to obtain synthetic dolomite by crystallisation of calcium and magnesium carbonates under different conditions, but without success. Probably mixtures of the composition of dolomite are formed from seawater, and undergo recrystallisation into dolomite by processes not yet discovered.

The following solubilities in water, saturated with carbon dioxide, at the ordinary temperature, were determined: crystallised magnesite, 0·08 gram; amorphous magnesite, 0·22 gram; and dolomite, 0·11 gram per litre. E. H. R.

A Complex Combination of Thallium and Hydrofluoric Acid. BARLOT (*Compt. rend.*, 1920, **171**, 1143—1145).—When thallium is dissolved in hot dilute hydrofluoric acid and the solution evaporated to dryness, a *compound*, H_2TlF_3, is obtained, which crystallises from water in white, elongated prisms. On heating, it gives off hydrogen fluoride, and its aqueous solution is acid, but does not attack glass, the fluorine ion being masked. The neutralisation curve indicates that this new complex acid can form two types of salts, $KHTlF_3$ and K_2TlF_3. The specific coefficient of magnetisation is 50% higher than the value calculated from the elements. W. G.

The Reaction between Nitric Acid and Copper. LANCELOT SALISBURY BAGSTER (T., 1921, **119**, 82—87).

Solubility of Cupric Hydroxide in Concentrated Sodium Hydroxide Solution. ERICH MÜLLER (*Zeitsch. angew. Chem.*, 1920, **33**, 303—305).—Cupric hydroxide dissolves in concentrated sodium hydroxide solution, yielding a violet-blue coloured solution; in the case of 48% sodium hydroxide solution, the latter may dissolve about 30 grams of copper per litre. The solution is not, however, stable. The author discusses the reaction, particularly as regards the cause of the decomposition, state of the dissolved copper, etc. W. P. S.

Density of Aluminium from 20° to 1000°. J. D. EDWARDS and T. A. MOORMANN (*Chem. Met. Eng.*, 1921, **24**, 61—64).—The density of liquid metals that do not attack quartz may be determined by ascertaining the apparent loss in weight of a hollow quartz cylinder loaded with iron or nickel and immersed in the molten metal. Aluminium, however, rapidly attacks quartz, especially at temperatures above 700°; the authors, therefore, used a densimeter consisting of a small graphite cylinder with a tightly fitting lid enclosed in a larger cylinder, filled to within ½ in. of the top of the smaller cylinder with molten aluminium in which a thermocouple was fixed. The smaller cylinder was filled with the molten metal, the lid screwed down, and the whole apparatus brought slowly to the desired temperature. After removing the metal that exuded from the opening provided in the lid, the metal in the outer cylinder was poured out, the apparatus allowed to cool, and the metal in the inner cylinder weighed. The volume of the cylinder had previously been determined by weighing the amount of mercury required to fill it, and due allowance was made for the expansion of the graphite. By this means it is found that liquid aluminium (99·75% Al), at its melting point (658·7°), had $D^{658\cdot7}$ 2·382, whilst the annealed solid metal has D^{20} 2·703. The density at temperatures above 658° is given by the equation $D_t = 2\cdot382 - [0\cdot000272(t-658)]$. The shrinkage on solidification is approximately 6·6%. A. R. P.

Hydrates of Aluminium Nitrate. KENZO INAMURA (*Mem. Coll. Sci. Kyōtō* 1920, **4**, 105—112).—See A., 1920, ii, 625.

The Transformation of Aluminium Silicates by Salt Solutions at Temperatures up to 200°. HANS SCHNEIDERHÖHN (*Jahrb. Min.*, 1915, *Beil. Bd.*, **40**, 163—228).—A statistical study of the work of Lemberg, Thugutt, and others, who carried out a very large number of analyses of the products obtained by the action of different salt solutions on many natural and synthetic aluminium silicates at temperatures up to 200°. It is shown that by the action of salt solutions on felspars, leucite, nepheline, zeolite, hauyn, sodalite, scapolite, as well as on amorphous synthetic silicates and on kaolin, allophane, etc., silicates of the type $R''O,Al_2O_3,xSiO_2,yH_2O$ are obtained as primary transformation products, in which the molecular ratio of base $R''O$ to alumina is always 1 : 1. By continued action of alkali hydroxides or carbonates, the product is left with $2SiO_2$. The amount of water present depends on the nature of the base and on the physical condition of the original material. In these primary products the base $R''O$ is readily exchanged by the action of other salt solutions with formation of secondary products. The silica content remains constant during such secondary transformations. Another type of compound is formed by the action on the silicates enumerated above of highly concentrated sodium hydroxide or carbonate solutions. The products are of the type $Na_2O,Al_2O_3,2SiO_2,yH_2O,zNaX$, where

X may be any organic or inorganic acid radicle. The molecular sum of the water and the added salt NaX always bears a simple ratio to the alumina. By the secondary action of other salt solutions the compounds of this type are decomposed, the combined salt NaX being detached and products formed similar to the secondary products of the first type. The physical and chemical properties of these substances are fully discussed, and their close relationship to the permutites is emphasised, particularly their amorphous character and easy susceptibility to basic exchange. E. H. R.

The Reduction of Permanganate by Arsenious Acid. MAX GELOSO (*Compt. rend.*, 1920, **171**, 1145—1148).—When potassium permanganate is reduced in acid solution by arsenious acid a green solution is obtained, from which, on keeping, a reddish-brown precipitate is obtained. The manganèse is reduced to a state corresponding with an oxide, Mn_8O_5, which, however, does not show the characteristics of a definite oxide. It is possible that the reduced solution contains a double salt, comprising a colourless manganous salt and a green, unstable salt in which the oxide, MnO_2, functions as a base (compare Frémy, this Journ., 1877, i, 52). W. G.

Electrolytic Preparation of Sodium Permanganate. C. O. HENKE and O. W. BROWN (*J. Physical Chem.*, 1920, **24**, 608—616).—A manganese anode containing 92·0% of manganese was used, the impurities being mainly iron, silicon, and carbon. The cathode was a perforated platinum plate. In all cases 350 c.c. of electrolyte are used, containing 10 grams of sodium hydroxide per litre. The addition of excess of calcium hydroxide to the solution raises the current efficiency at 25° from 16·4% to 32·8%. The calcium hydroxide appears to form a film over the cathode, which acts as a diaphragm. The current efficiency is greatest (38%) at a current density of 13 amperes per sq. dcm. at low temperatures (8°). It appears that the efficiency increases as the temperature decreases. The higher the valency with which the metal goes into solution the higher is the discharge potential. J. R. P.

Solubility of Metals in Acids containing Formaldehyde. ROGER C. GRIFFIN (*J. Ind. Eng. Chem.*, 1920, **12**, 1159—1160).—The presence of 1% of formaldehyde in dilute sulphuric acid or hydrochloric acid (1:1) decreases very considerably the solvent action of these acids on wrought iron, cast iron, and steel; the effect is less in the case of 10% nitric acid, possibly on account of secondary reactions. The solvent action of the acids on brass, tin, solder, and nickel is not greatly affected by the presence of formaldehyde. W. P. S.

Chemistry and Crystallography of some Fluorides of Cobalt, Nickel, Manganese, and Copper. FLOYD H. EDMINSTER and HERMON C. COOPER (*J. Amer. Chem. Soc.*, 1920, **42**, 2419—2433).—The fluorides of cobalt, nickel, manganese, and

copper can be prepared by dissolving either the hydroxide or the carbonate of the metal in hydrofluoric acid. The same derivative is obtained whichever compound is used. In all cases a crust-like product was obtained when the original solution was evaporated. From the slightly acidified (HF) water extract, crystals of the acid fluorides were obtained, which have the general formula

$$MF_2,5HF,6H_2O.$$

These fluorides are not permanent in the air, but decompose, losing hydrogen fluoride, and in the case of the copper compound water is also lost. The formation of the hydrated crystalline crust is distinct from that of the hydrated acid crystals. In this crust the ratio of metal to fluorine for the cases cobalt and nickel was found to be approximately 1:2 with a varying water content. The crust differs from the crystals in solubility and form, as well as in composition. The acid fluorides of cobalt, nickel, and manganese form rhombohedral crystals with prismatic cleavage, parallel extinction, and uniaxial positive character, and therefore constitute an isomorphous series. The acid fluoride of copper crystallises in the monoclinic system; it is pleochroic, and shows three cleavages parallel to three faces. The salts have the following densities: cobalt, 2·0445; nickel, 2·006; manganese, 1·921; and copper, 2·4055. From the original preparation of copper fluoride, small crystals of the normal fluoride, $CuF_2,2H_2O$, were obtained, which were too small for measurement. On recrystallising these from water they reverted into the acid fluoride. J. F. S.

Properties of Subsidiary Valency Groups. I. Molecular Volume Relationships of the Hydrates and Ammines of some Cobalt Compounds. II. Subsidiary Group Mobility as Studied by the Heat Decomposition of some Cobalt-ammines. George L. Clark, A. J. Quick, and William D. Harkins (*J. Amer. Chem. Soc.*, 1920, **42**, 2483—2498).—The specific gravity of a number of cobalt derivatives has been determined at 25° with the object of ascertaining the influence of the volume of the constituents on the stability of the cobalt ammines and hydrates. The methods of preparation and analysis are described in all cases. The following values of the specific gravity at 25° are recorded: anhydrous cobaltous chloride, 3·356; cobaltous chloride hexahydrate, 1·924; cobaltous chloride dihydrate, 2·477; hexamminecobaltous chloride, 1·497; pentamminecobaltous chloride monohydrate, 1·559; pentamminecobaltous chloride, 1·580; tetramminecobaltous chloride, 1·593; diamminecobalt chloride, α 2·097, β 2·073; pentamminecobaltic chloride, 1·819; aquopentamminecobaltic chloride, 1·776; hexamminecobaltic chloride, 1·744; anhydrous cobaltous sulphate, 3·710; cobaltous sulphate heptahydrate, 1·948; cobaltous sulphate hexahydrate, 2·029; cobaltous sulphate tetrahydrate, 2·368; pentamminecobaltous sulphate, 1·703; and tetramminecobaltous sulphate dihydrate, 1·805. The molecular volume is calculated in each case, and from these values the apparent volume of the subsidiary group in the compound is calcu-

lated, and the percentage compression. It is shown that water and ammonia in subsidiary groups have volumes in the ratio 14·265 : 19·33. The volume of the ammonia group in the cobaltous chloride ammines increases in passing from the hexammine to the diammine. *Decammine cobaltous chloride* has been prepared as a brown powder, D 1·71, by passing ammonia over anhydrous cobalt chloride, which is nearly colourless for many hours; the hexammine is first formed, and then, after several hours, the colour slowly changes to brown. The existence of this compound is not well established; it has been obtained twice, but both times from portions of the same specimen of cobalt chloride; other specimens of cobalt chloride did not give it. Analysis of the brown compound gave NH_3 0·5661, Co 0·1966, Cl 0·2358; $Co(NH_3)_{10}Cl$ requires NH_3 0·5673, Co 0·1964, Cl 0·2362. The vapour-pressure curve lies very much above that of the hexammine, and, on keeping, it loses its colour and passes into the hexammine. The preparation of the compound is probably dependent on the amount of moisture present in the anhydrous chloride. The effect of heat on certain ammine derivatives of cobalt has also been investigated. In the case of hexamminecobaltic chloride, an evolution of ammonia commenced at 173°, and at 181° ammonium chloride sublimed, with the formation of chloropentamminecobaltic chloride, $[Co(NH_3)_5Cl]Cl_2$; on raising the temperature to 260°, the decomposition is represented by the equation $6[CoCl_3,6NH_3] \longrightarrow 6CoCl_2 + 6NH_4Cl + N_2 + 28NH_3$. With mononitropentamminecobaltic chloride, a notable gas pressure was observed at 100°, whilst at 210° rapid evolution of gas took place. The gas liberated below 248° consisted of 70·3 c.c. nitrogen and 16·8 c.c. ammonia. The decomposition is represented by $[Co(NH_3)_5(NO_2)]Cl_2 \longrightarrow NH_3 + 2NH_4Cl + NH_4{\cdot}NO_2 + CoN$; $NH_4{\cdot}NO_2 \longrightarrow N_2 + 2H_2O$; $2CoN + 3H_2O \longrightarrow Co_2O_3 + 3NH_3$. In the case of trinitrotriamminecobalt, slight evolution of gas commences at 158°, but at 164° decomposition takes place with almost explosive violence, forming nitrogen, water, and cobaltic oxide, according to the equations

$$2[Co(NH_3)_3(NO_2)_3] \longrightarrow 2CoN + 2HNO_2 + 4NH_4{\cdot}NO_2;$$
$$4NH_4{\cdot}NO_2 \longrightarrow 4N_2 + 8H_2O;\quad 2CoN + 2HNO_2 \longrightarrow Co_2O_3 + H_2O + 2N_2.$$

J. F. S.

Physical Properties of Nickel. P. D. Merica (*Chem. Met. Eng.*, 1921, **24**, 73—76).—A compilation of the most trustworthy results obtained for the thermal, electrical, magnetic, mechanical, and optical properties of pure and commercial qualities of nickel. A. R. P.

The Hexabasic Polymolybdates. S. Posternak (*Compt. rend.*, 1920, **171**, 1213—1215. Compare this vol., ii, 51).—When increasing quantities of hydrochloric acid are added to a saturated solution of hexammonium heptamolybdate, a series of hexabasic polymolybdates having the general formula

$$(NH_4O)_3MoO(O{\cdot}MoO_2)_mO{\cdot}MoO(ONH_4)_3 + nH_2O$$

are obtained. Of these, the following have been prepared: the *nonamolybdate*, the *undecamolybdate*, the *dodecamolybdate, hydroxypentammonium tridecamolybdate, dihydroxytetrammonium tridecamolybdate*, and *trihydroxytriammonium tridecamolybdate*, $(NH_4O)_3MoO(O{\cdot}MoO_2)_{11}O{\cdot}MoO(OH)_3,19H_2O$. All these polymolybdates are transformed by an excess of alkali into orthomolybdates, for which the author suggests the constitution of hexabasic trimolybdates, $(RO)_3MoO{\cdot}O{\cdot}MoO_2{\cdot}O{\cdot}MoO(OR)_3+nH_2O$.

W. G.

The Tetrabasic Polymolybdates. S. POSTERNAK (*Compt. rend.*, 1921, **172**, 114—117. Compare this vol., ii, 51, and preceding abstract).—If 25 c.c. of $2N$-sulphuric acid and 10 grams of ammonium sulphate are added to 100 c.c. of a 10% solution of ammonium molybdate, ammonium trihydrogen tetramolybdate, $NH_4O{\cdot}(OH)_2MoO(O{\cdot}MoO_2)_3{\cdot}OH,5H_2O$, described by Rosenheim as an octamolybdate (A., 1897, ii, 497), is obtained. In a vacuum over sulphuric acid, this salt loses its $5H_2O$, and a further molecule of water at 130—160°. Its aqueous solution when warmed at 40° gives needle-shaped crystals of ammonium trihydrogen pentamolybdate, $NH_4O{\cdot}(OH)_2MoO(O{\cdot}MoO_2)_4{\cdot}OH$, described by Rosenheim and Felix as a decamolybdate (A., 1913, ii, 224). If the tetramolybdate is recrystallised twice from water at 75°, the insoluble portion being filtered off, it gives triammonium trihydrogen tridecamolybdate, $(NH_4O)_3MoO(O{\cdot}MoO_2)_{11}O{\cdot}MoO(OH)_3,19H_2O$, the insoluble portion being ammonium trihydrogen hexamolybdate, $NH_4O{\cdot}(OH)_2MoO(O{\cdot}MoO_2)_5{\cdot}OH,H_2O$. All these tetrabasic polymolybdates, which contain, at the most, seven molybdic groups, arise from the decomposition of a more complex salt, which the author has separated by dialysis as *ammonium pentahydrogen tridecamolybdate*, $NH_4O{\cdot}(OH)_2MoO(O{\cdot}MoO_2)_{11}O{\cdot}MoO(OH)_3$.

The condensation of molybdic acid thus reaches its limit by the formation of tridecamolybdic acid. The current classification into ortho-, meta-, and para-molybdates is unsatisfactory. There only exist two groups of molybdates: (1) the hexabasic polymolybdates, of which the ortho- and para-molybdates are only particular cases; (2) the tetrabasic polymolybdates, which arise from the former by hydrolytic rupture of their chain. W. G.

Hydrolysis of Zirconyl Chloride and Sulphate at 0° and 20°. F. P. VENABLE and D. H. JACKSON (*J. Amer. Chem. Soc.*, 1920, **42**, 2531—2534).—The hydrolysis of $0{\cdot}2M$-, $0{\cdot}1M$-, and $0{\cdot}01M$-solutions of zirconyl chloride and zirconyl sulphate has been followed by the change in the relative conductivity with time at 0° and 20°. The conductivity increases slowly for three to four hours, at which point the experiments were interrupted. There appears to be in all cases an initial temperature adjustment on dissolving the salts, which is more noticeable at the higher temperature. A further set of experiments were carried out with zirconyl

chloride at the same temperatures and concentrations, in which 25-c.c. portions of the solution were withdrawn from time to time, and the ratio ZrO_4/IO_3 determined by titrating with iodic acid. Here also the temperature adjustment is to be observed. The precipitates obtained with iodic acid indicate the probable existence of the basic iodates $3ZrO(OH)_2,4ZrO(IO_3)_2$, $2ZrO(OH)_2,ZrO(IO_3)_2$, $ZrO(OH)_2,2ZrO(IO_3)_2$, and $3ZrO(OH)_2,2ZrO(IO_3)_2$. These compounds are obtained by washing the precipitates with either hot or cold water. J. F. S.

Revision of the Atomic Weight of Bismuth. A. CLASSEN and O. NEY (*Ber.*, 1920, **53**, [*B*], 2267—2270).—Magnesium phenyl bromide is treated with an excess of bismuth bromide (redistilled; in some cases made from pure metal) in ethereal solution, and the product is decomposed by ice-water and distilled in a current of steam. The residual non-volatile *bismuth triphenyl*, $BiPh_3$, m. p. 77·6°, is purified by crystallisation from absolute alcohol, and distillation (b. p. 242°/14 mm., 208°/0·07 mm.), and for the purpose of atomic-weight determination is left for ten hours over phosphoric oxide in a cathode-ray vacuum before weighing. Transference into bismuth oxide is effected by mixing weighed portions with pure oxalic acid in a porcelain crucible, moistening with pure alcohol, heating in an electric quartz muffle furnace at 250° (twenty hours), 250—400° (five hours), then 750°, and finally igniting in a stream of oxygen. From ten values of the ratio $2BiPh_3 : Bi_2O_3$, the atomic weight of bismuth is obtained as 208·920 (lowest), 209·072 (highest), and in mean, Bi = 208·9967, a value which agrees with Hönigschmid and Birckenbach's recent determination (A., 1920, ii, 549). J. C. W.

Mineralogical Chemistry.

The Chemistry of the Earth's Crust. HENRY S. WASHINGTON (*J. Franklin Inst.*, 1920, **190**, 757—815).—The chemical composition of the materials of the earth is discussed. Elements are divided into two groups: (1) petrogenic elements, characteristic of igneous rocks, and of low atomic weight; (2) metallogenic elements, rare or absent in igneous rocks, but occurring in ores of high atomic weight. Beneath the silicate crust it is suggested that there is a zone essentially of nickel–iron, and below this a central core of metallogenic elements. The average densities of the continents, ocean floor, and various smaller regions of the earth appear to be inversely as their elevations. J. R. P.

Classification of the Sulpho-salt Minerals. EDGAR T. WHERRY and WILLIAM F. FOSHAG (*J. Washington Acad. Sci.*, 1921, **11**, 1—8).—The scheme previously outlined (A., 1920, ii, 764) is carried on for this group. The main divisions are based on the ratios of acid to basic sulphides, and the groups on the crystalline form. Minerals containing both univalent and bivalent metals are regarded as double compounds rather than as isomorphous mixtures. The sulpharsenate–sulphantimonate division is discarded, enargite, for example, being placed in the enargite (orthorhombic) group of the 5 : 1 division, and the formula written as $Cu_2S,4CuS,As_2S_8=Cu_3AsS_4$. L. J. S.

Secondary Sulphide Ore Enrichment: Copper Sulphides and Hydrogen Sulphide. S. W. YOUNG and NEIL PRESTON MOORE (*Econ. Geol.*, 1916, **11**, 349—365).—Fragments of massive chalcocite, chalcopyrite, bornite, or covellite were kept in sealed tubes for several weeks at 30° with liquid hydrogen sulphide and water or sulphuric acid ($N/10$), or potassium sulphide ($10N$—$N/10$-solutions). The acid and strongly alkaline solutions had little action, the greatest changes being effected by the neutral solution. "Blue" chalcocite gives a brown, colloidal solution, which flocculates and deposits a sooty coating on the fragment; this coating afterwards crystallises as small, six-sided plates of chalcocite. Iron (2%), present as an impurity in the original material, gave rise to chalcopyrite. Bornite breaks down into crystallised chalcopyrite, chalcocite, and covellite. "White" ("pseudo-hexagonal") chalcocite, chalcopyrite, and covellite are only slightly attacked. L. J. S.

Sulphide Ore Enrichment: Formation of Chalcopyrite. S. W. YOUNG and NEIL PRESTON MOORE (*Econ. Geol.*, 1916, **11**, 574—581).—Chalcocite and covellite were kept in sealed tubes for several weeks at 30° with liquid hydrogen sulphide, water, and an iron compound (ferrous sulphate, ferrous sulphide, or magnetite). A crust of pyrrhotite crystals was formed at the junction of the solution and the liquid hydrogen sulphide. Chalcocite gives rise to the formation of chalcopyrite, but covellite is only slightly attacked. When the chalcocite and magnetite are in actual contact, the action is much more intense. Bornite (Cu_5FeS_4) is probably a molecular compound of $CuFeS_2$ (chalcopyrite) and $2Cu_2S$ (chalcocite), and chalcopyrite is perhaps Cu_2S,FeS,FeS_2.
L. J. S.

A Crystalline Normal Dolomite from the Kneifelspitze, Berchtesgaden, Bavaria. EMANUEL GLATZEL (*Centr. Min.*, 1919, 289—293).—The dolomite is found in the form of rock-fragments of varying size, distinguished from the surrounding, pale yellow limestone by their white colour. The fragments are much weathered, and show on the surface a fine-grained, crystalline, sugar-like structure. The dolomite has D 2·792, contains only a

trace of hygroscopic water, dissolves practically completely in hydrochloric acid, and corresponds in composition with normal dolomite, $CaCO_3,MgCO_3$. E. H. R.

Orthoclases containing Barium. G. TSCHERMAK (*Tsch. Min. Mitt.*, 1914, **32**, 543—544).—Analysis I, by R. ZSIGMONDY, is of twinned crystals, D 2·575, of sanidine, from Samothrace Island, Ægean Sea; II, by E. Kolisko, of pure, water-clear adularia, from the St. Gothard district:

	SiO_2.	Al_2O_3.	Fe_2O_3.	BaO.	K_2O.	Na_2O.	Total.
I.	64·76	19·61	0·46	1·17	9·75	3·32	99·07
II.	64·47	19·29	—	0·78	14·11	1·43	100·08

L. J. S.

Composition of Aluminous Augites. G. TSCHERMAK (*Tsch. Min. Mitt.*, 1914, **32**, 520—534).—A discussion of recent analyses in the light of the theory [mixing of the molecules $Ca(Mg,Fe)Si_2O_6$ and $MgAl_2SiO_6$] proposed by the author in 1871, and a criticism of Boeke's work (A., 1914, ii, 283). Although the compound $MgAl_2SiO_6$ has not been prepared artificially, its existence is probable. The corresponding calcium compound, $CaAl_2SiO_6$, and $Mg_2Si_2O_6$ (clinoenstatite), are also assumed to be present to explain certain analyses. L. J. S.

Analysis of Rumpfite. G. TSCHERMAK (*Tsch. Min. Mitt.*, 1914, **32**, 542—543).—Material from the original locality in Styria is compact to fine grained, with pale yellowish-green colour, and often encloses small crystals of dolomite. Detached scales are optically positive with weak birefringence and variable axial angle, the optic axial plane being parallel to a side of the hexagonal outline. These optical characters are those of clinochlore, and the following analysis, by T. PANZER, agrees closely with that of typical clinochlore from Achmatovsk. Material dried at 100° contains 12·39% H_2O. The alkalis and slight excess of silica are referred to intermixed mica:

SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	K_2O.	Na_2O.	H_2O.	Total.
31·31	20·07	0·82	1·36	33·30	0·85	0·39	12·87	100·97

L. J. S.

A Diopside containing Manganese from the Radautal near Harzburg. J. UHLIG (*Jahrb. Min.*, 1914, *Beil. Bd.*, **39**, 446—449).—Analysis of the mineral gave the following result:

SiO_2.	TiO_2.	Al_2O_3.	FeO.	MnO.	MgO.	CaO.	Loss on ignition.	Total.
51·92	0·31	2·54	6·16	1·08	12·49	24·76	0·44	99·70

The mineral is to be regarded as a diopside rather than a pyroxene. It contains too little manganese to be classed as a "schefferite." It occurs embedded in prehnite in growths 0·1 mm. thick and 0·5—0·75 mm. long or in tiny, pale red veins of much smaller dimensions. It has D 3·30—3·33, mean refractive index 1·68. E. H. R.

Anthophyllite from Moravia. KARL SCHIRMEISEN (*Tsch. Min. Mitt.*, 1914, **32**, 512—519).—At Podoli, near Bobrau, granite is intrusive into a bronzite-bearing serpentine, and it contains embedded blocks and nodules of the serpentine. At the contact between the two rocks, and also surrounding the embedded blocks of serpentine, is a zone, 1—1·5 cm. thick, of fibrous anthophyllite, the fibres of which are arranged perpendicularly to the contact. Some biotite and actinolite are also present. The anthophyllite is almost colourless; it is orthorhombic and optically positive, with wide axial angle, D 3·0. Analysis by M. KREBS gave:

SiO_2.	Al_2O_3.	FeO.	MnO.	CaO.	MgO.	Alkalis.	H_2O.	Ign.	Total.
56·34	2·33	9·76	2·05	0·80	23·39	0·60	1·13	1·64	98·04

These minerals are clearly of contact-metamorphic origin; the anthophyllite and actinolite were evidently formed by the addition of silica from the granite magma to the olivine of the peridotite, whilst the biotite may have arisen by the addition of magnesium silicate from the peridotite to the muscovite of the granite.

L. J. S.

Enclosures in Styrian Basalt-tuffs. JOS. SCHADLER (*Tsch. Min. Mitt.*, 1914, **32**, 485—507)—Basalt-tuffs containing blocks ("bombs") of various rocks foreign to the basalt occur at several places in southern Styria. The olivine-bombs (bulk analysis I) agree closely in composition with lherzolite, and contain olivine, 50·8; bronzite, 28·4; chrome–diopside, 13·8; picotite, 6·4; H_2O, 0·4%. Dilute hydrochloric acid dissolves the olivine portion, the silica of which also goes into solution; analyses are given of the soluble (II) and insoluble portions. When exposed to the weather, these olivine-bombs become coated with a green, earthy crust (anal. III), due to the alteration of the olivine to a mixture of minerals (differing apparently from serpentine). Analyses are also given of the soluble (IV) and insoluble portions; in this case very little silica goes into solution, but potassium hydroxide solution extracts 3·32% of free silica:

	SiO_2	Al_2O_3.	Cr_2O_3.	Fe_2O_3.	FeO.	CaO.	MgO.	H_2O.	Total.
I.	43·01	3·01	0·28	3·62	5·89	2·92	38·54	0·94	99·83*
II.	29·10	0·12	—	7·01	—	—	26·62	0·38	63·25
III.	47·37	2·50	0·89	8·66	2·88	3·07	22·71	9·14	99·72†
IV.	0·68	0·06	—	9·09	—	0·91	12·06	9·20	31·67
V.	40·72	nil	—	—	9·47	nil	49 88	—	100·07
VI.	53·40	3·66	0·34	4·66	4·04	0·75	33·16	0·26	100·27
VII.	49·87	5·44	1·76	2·95	2·50	20·74	16·26	0·55	99·87
VIII.	39·66	14·27	—	5·07	5·10	10·78	14·56	0·49	100·06‡
IX.	47·99	9·36	—	2·48	3·56	19·97	14·87	0·59	100·59§

Incl. insoluble 1·62. † Incl. insoluble 2·50.
‡ Incl. TiO_2 4·60, MnO trace, K_2O 2·10, Na_2O 3·52. § Incl. TiO_2 1·25.

The pale yellow, transparent olivine gave V, D 3·351, corresponding with $Fe_2SiO_4:Mg_2SiO_4=1:9·35$. The powdered mineral lost 0·35% at 150° and gained 1·05 at a red-heat, corresponding with the conversion of the whole of the ferrous oxide into ferric oxide. The

brown bronzite gave VI, D 3·318, corresponding with $(Mg,Fe)SiO_3$, 70·51; $(Mg,Fe)(Al,Fe,Cr)_2SiO_6$, 23·38; $(Mg,Fe)CaSi_2O_6$, 6·11 mol %. The leek-green chrome-diopside gave VII, D 3·337, corresponding with $(Mg,Fe)CaSi_2O_6$, 85·71; $(Mg,Fe)(Al,Fe,Cr)_2,SiO_6$, 14·29 mol. %.

Other bombs consist of hornblende and augite, either alone or with biotite and olivine. The black basaltic hornblende gave VIII, D 3·266; this composition is discussed; it agrees with Penfield's formula (A., 1907, ii, 102) only when the large amount of titanium is reckoned as Ti_2O_3. The augite (IX) is pale greyish-green in thin section, D 3·323; here the titanium is reckoned as TiO_2 to obtain a metasilicate formula. L. J. S.

Analytical Chemistry.

Weighing of the Precipitation Vessel with the Precipitate in Quantitative Micro analyses. Two Methods based on this Principle. ERICH GARTNER (*Monatsh.*, 1920, **41**, 477—498). —Two methods are described which permit of the estimation of precipitates weighing 2—15 mg. with sufficient accuracy, the only requisites being a Kuhlmann microchemical balance and such simple apparatus as is easily constructed. In each case the whole of the operations are carried out in a single vessel, this being either an asbestos filter-tube or a pointed centrifuge-tube. A tare of slightly less (1—2 mg.) weight than the vessel is prepared, the three necessary weighings then requiring only the tare, a 1 cg. weight, and the rider. Adhesion of the precipitate to the wall of the vessel causes no error, and both procedures are found to give accurate results.

T. H. P.

The Importance of Adsorption in Analytical Chemistry. III. The Adsorption of Acid by Filter Paper. I M. KOLTHOFF (*Pharm. Weekblad*, 1920, **57**, 1571—1577).—Filter paper cut into pieces of about 0·5 cm.^{2} surface were kept in an atmosphere saturated with water-vapour until no further increase of weight took place. Weighed quantities were then gently shaken with dilute acid solutions of known strength, and after equilibrium was reached, aliquot quantities were drawn off and titrated. The first paper employed gave results conforming to the adsorption equation $X/m = ac^{1/n}$, where X/m is the number of milli-mols. taken up by 1 gram of the paper, c is the end concentration of the acid, and a and $1/n$ are constants. By titrating the anion, it was found that only hydrion was adsorbed. The results held only for very low concentrations of acid, and were found to apply to hydro-

chloric, nitric, sulphuric, and oxalic acids, the constants being the same for all these.

The work could not be completed, as no further supplies of the particular paper used could be obtained. Other standard filter papers were then examined, and it was found in all cases that the amount of acid adsorbed was constant, and was exactly equivalent to the alkalinity of the ash. Cotton-wool in which the ash had been reduced to a minimum by treatment with hydrofluoric acid was found to adsorb scarcely at all. The taking-up of acids by filter paper, therefore, appears to be entirely a chemical action.

S. I. L.

Action of Surface Adhesion in Ring Reactions. F. Reiss (*Zeitsch. öffentl. Chem.*, 1920, **26**, 281—283. Compare A., 1919, ii, 166).—The author and G. Diesselhorst have shown (*loc. cit.*) that the greater the surface of contact between two layers of liquid, the more sensitive is the reaction in such cases as the diphenylamine reaction for nitrates; this increase in surface may be attained by carrying out the reactions in test-tubes containing colourless glass beads.

W. P. S.

Normalities of Standard Solutions. Yukichi Osaka (*Mem. Coll. Sci. Kyōtō* 1920, **4**, 113—125).—See A., 1920, ii, 187, under the title, "Influence of Temperature on the Strength of Standard Solutions in Quantitative Analysis."

The New Indicator. R. W. Kinkead (*Chem. News*, 1921, **122**, 4—5).—By the action of ethyl nitrate on magnesium phenyl bromide a deep blue solution was obtained, which had the properties of an indicator, turning pink with acids and blue with alkalis.

J. R. P.

Volumetric Estimation of Mixtures of Acids and of Bases, and of Polybasic Acids or Bases. Henry Thomas Tizard and Alfred Reginald Boeree (T., 1921, **119**, 132—142).

The Application of Conductivity Titrations in Analysis. I. M. Kolthoff (*Chem. Weekblad*, 1920, **17**, 694—701).—The conductivity-titration of a strong acid with a strong base, and *vice versâ*, is of importance where very dilute or coloured solutions must be examined. With weaker acids and bases, the straight lines which make the determination so accurate in the first case are not obtained. The curves obtained may be regarded as resulting from the superposition of two lines, one the conductivity of the dissociated fraction of the acid or base, the other the conductivity of the neutral salt formed; the latter line starts at the origin, and meets both the actual conductivity curve determined by measurement and the curve resulting from addition of excess of reagent, and by plotting it independently, the end-point can be accurately found in all cases. In the case of a weak acid being titrated with sodium hydroxide, for example, the determination is carried out in the usual

way. A "salt line" is then obtained by adding to a volume of water equal to the volume of the dilute acid solution used, increasing quantities of the sodium salt of the acid, in solution of equivalent concentration to the sodium hydroxide solution used, and at the same temperature. This salt line is plotted on the same diagram, and intersects the line given by the titration at the neutralisation point.

For very weak acids and bases, good results can be obtained only if the concentration and the dissociation constants are within certain limits; thus phenol, boric acid, hydrocyanic acid, and others which have a dissociation constant in $N/10$-solution not less than 10^{-10} (or for $N/100$-solutions not less than 10^{-9}) can be accurately determined. For bases, the minimum dissociation constant in $N/10$-solutions is $1{\cdot}6 \times 10^{-10}$; thus hexamethylenetetramine can readily be titrated in $N/10$- or $N/100$-solution with N-hydrochloric acid, as can also aniline and many of its derivatives, alkaloids, etc. A weak acid can be accurately titrated with a weak base, and vice versâ, if the dissociation constants are not less than 3×10^{-6}, the dilutions here being unimportant.

The same principles may be applied to the titration of a weak acid in presence of one either much stronger or much weaker, provided that the dissociation constants fall within the necessary limits. Where these limits are exceeded, the salt line may be plotted, or resort may be had to addition of alcohol, by means of which the dissociation constants of most organic acids are greatly reduced. The case of polybasic acids, and the displacement of a weak acid or base by a stronger one, can also be satisfactorily dealt with if the dissociation constants are not too close to one another.

S. I. L.

Catalysis of Permanganate Titrations. PAUL H. SEGNITZ (*J. Ind. Eng. Chem.*, 1920, **12**, 1196—1197).—The addition of a small quantity of manganese sulphate solution considerably increases the rate of reaction between permanganate and hydrogen peroxide or sodium oxalate; the use of the catalyst does not affect the end-point of the titration. W. P. S.

Apparatus for Gas Analysis by Absorption and Titration. R. S. TOUR (*Chem. Met. Eng.*, 1920, **23**, 1104—1106).—For determining the volume of residual gas, after absorption of one constituent of a gas by a suitable reagent, a gas-volume compensometer may be used. The apparatus comprises a gas-flask which can be connected at one end by means of a two-way tap either to the absorber or to one limb of a manometer, the other limb of which is expanded into a compensometer and is completely enclosed by the gas flask. The other end of the flask is connected with a reservoir, and two marks on the flask serve to indicate a zero and a convenient volume for displacement. After the flask has been filled with water, communication is established with the absorbing vessel, and the residual gas is drawn in by discharging a certain quantity of water. The flask is then connected with the manometer, and the correction

factor, or the corrected volume at 760 mm., 0°, dry, is read off on the scale. The amount of the absorbed constituent in the original gas is calculated from $100-Y/Y=VJ/22 \cdot 4NQ$, where Y=the percentage of constituent, V=vol. in c.c. of residual gas, corrected to standard conditions, J=valency of absorbed constituent, N=normality of reagent, Q=c.c. of reagent used for titration. The apparatus gives an accuracy of ±0·5%. The use of a nomograph facilitates the graphical solution of the above equation. The methods of calibrating the apparatus to determine the compensometer constant and of graduating the manometric scale are described. W. J. W.

Estimation of Chlorides in Blood. A. S. WETMORE (*J. Biol. Chem.*, 1920, **45**, 113—118).—The sample of blood is collected in dry potassium oxalate, and the proteins removed by a precipitation of cupric hydroxide. An addition of calcium hydroxide powder to the filtrate is then made to remove the oxalate and most of the phosphate. After filtration, the chlorides are precipitated by adding an excess of standard silver nitrate solution, and the estimation made by titrating the excess with potassium thiocyanate. J. C. D.

The Microchemical Reactions of Iodic Acid. G. DENIGÈS (*Compt. rend.*, 1921, **172**, 62—63. Compare A., 1920, ii, 388, 555, 706, 751; *Bull. Soc. Pharm. Bordeaux*, 1920, **211**).—A claim for priority over Bolland (this vol., ii, 57). W. G.

Analysis of Mineral Sulphide Water. J. G. FAIRCHILD (*J. Washington Acad. Sci.*, 1920, **10**, 559—565).—The alkalinity of a water-containing alkali and alkaline earth hydrosulphides and hydrogen carbonates increases continuously with the escape of hydrogen sulphide or with the precipitation of sulphur. The acidity of calcium and magnesium chlorides towards the alkali sulphides is pronounced, but has less effect on the hydrogen carbonates. Although the addition of a small quantity of barium chloride solution to an ordinary carbonate water aids in the decomposition of the hydrogen carbonate ions, it has no such effect if the water contains a considerable quantity of alkali sulphides. A method proposed for the estimation of the carbon dioxide present as hydrogen carbonate and of volatile hydrogen sulphide consists in boiling a quantity of the water for five minutes in a rapid current of pure hydrogen, and absorbing the carbon dioxide and hydrogen sulphide in an ammoniacal solution containing cadmium chloride and barium chloride. This solution is then acidified with acetic acid, and the liberated carbon dioxide is collected; the hydrogen sulphide remains fixed as cadmium sulphide. W. P. S.

Water Analysis. V. [Estimation of Sulphuric Acid.] L. W. WINKLER (*Zeitsch. angew. Chem.*, 1920, **33**, 311—312. Compare A., 1915, ii, 173; 1916, ii, 194, 448; 1917, ii, 501).—An approximate estimation of sulphuric acid in potable waters

is obtained by observing the time taken by the clear liquid to develop the first signs of cloudiness when to 5 c.c. of the sample, acidified with 2·5 c.c. of 10% hydrochloric acid, 2·5 c.c. of 10% barium chloride solution are added. The test is conveniently carried out beside a blank in two test-glasses standing on a black surface to facilitate observation, and the mg. of SO_3 per litre corresponding with the time are obtained either from the table given, or, preferably, by actual tests on dilute sulphuric acid solutions of known strength. The upper and lower limits of concentration for the purpose of this test are about 100 mg. and 10 mg. of SO_3 per litre, the corresponding times being five seconds and five minutes respectively, and the limits of error may be within 5 mg. at the lower concentrations and 10 mg. at the higher concentrations. For a gravimetric estimation of sulphates, it is generally necessary to concentrate by evaporation unless large quantities are present, but inaccurate results are obtained unless calcium is first removed by precipitation with 0·5—1·0 gram of sodium hydroxide and 1—2 grams of sodium carbonate per litre, the precipitate being allowed to settle, and 1000 c.c. of the supernatant, clear liquid evaporated to dryness after acidification with hydrochloric acid. The residue is then dissolved in 25 c.c. of water, filtered from silicic acid, and the sulphuric acid estimated as previously described (A., 1920, ii, 504). G. F. M.

The Use of Permanganate in the Kjeldahl Method modified for Nitrates. I. K. Phelps (*J. Assoc. Off. Agric. Chem.*, 1920, **4**, 69—71).—In the estimation of nitrates by the modified Kjeldahl process with a sulphuric acid–salicylic acid mixture, the addition of potassium permanganate at the end of the boiling may cause the loss of nitrogen, and it should therefore be omitted. W. G.

Investigation of the Kjeldahl Method for Estimating Nitrogen. I. K. Phelps and H. W. Daudt (*J. Assoc. Off. Agric. Chem.*, 1920, **4**, 72—76).—For the digestion in open flasks, 25 c.c. of sulphuric acid and 10 grams of potassium sulphate, or 8·2 grams of sodium sulphate, may be used without loss of ammonia. If the amount of acid is reduced to 15 c.c., the loss of ammonia is very small, but if the amounts of sulphates used are appreciably increased, losses of ammonia occur. The hydrolysis of refractory substances like pyridine zinc chloride is complete if the substance (0·4 gram) is boiled for two and a-half hours with a mixture of 0·7 gram of mercuric oxide, 10 grams of potassium sulphate, and 25 c.c. of acid in an open flask.

The influence of the reagents and the apparatus on the accuracy of the modified Kjeldahl process is indicated, and in routine work the results should be controlled by blank experiments. W. G.

Influence of Potassium Permanganate on Kjeldahl Nitrogen Estimations. Donald C. Cochrane (*J. Ind. Eng. Chem.*, 1920, **12**, 1195—1196).—Comparative estimations of

nitrogen in feeding stuffs and fæces by the Kjeldahl method, with and without the addition of permanganate, showed that uniformly higher results were obtained when permanganate was used, provided that the latter was added about ten seconds after the acid digestion mixture ceased to boil. W. P. S.

Micro-estimation of Nitrogen in Agricultural Materials. W. GEILMANN (*J. Landw.*, 1920, **68**, 235—249).—A description of a micro-method for the estimation of nitrogen in proteins, ammonium salts, etc., using only a few mg. for the estimation; the method consists essentially in a micro-Kjeldahl digestion, followed by the liberation of the ammonia formed either by steam distillation or by aspiration with a current of air after the mixture has been rendered alkaline. The ammonia is absorbed in $N/70$-acid, and the excess of this is titrated with $N/70$-alkali solution, using methyl-red as indicator. W. P. S.

Gasometric Estimation of Nitrogen and its Application to the Estimation of the Non-Protein Nitrogen of Blood. R. L. STEHLE (*J. Biol. Chem.*, 1920, **45**, 223—228).—The first step is to treat the substance by the usual Kjeldahl digestion, after which decomposition with sodium hypobromite is carried out. The method is stated to possess certain advantages over the usual Kjeldahl method. J. C. D.

Iodometric Estimation of Amino-Nitrogen in Organic Substances. H. H. WILLARD and W. E. CAKE (*J. Amer. Chem. Soc.*, 1920, **42**, 2646—2650).—The Kjeldahl method of estimating nitrogen can be hastened by adding solid potassium persulphate to the cold, charred solution of organic matter in concentrated sulphuric acid. Water must be excluded, otherwise some oxidation of ammonia occurs. The mixture is warmed carefully for about one minute until colourless, and then boiled to decompose excess of persulphate. The solution may now be cooled, diluted, rendered just alkaline, and the ammonia titrated by means of standard sodium hypobromite solution (compare Artmann and Skrabal, A., 1907, ii, 196). J. C. W.

Estimation of Nitrogen Oxides in Gases. G. B. TAYLOR (*Chem. Met. Eng.*, 1920, **23**, 1112).—A 2-litre bottle is filled with the gas to be examined, oxygen being passed in if not present in sufficient quantity to convert nitric oxide into peroxide, and the pressure and temperature are recorded. Twenty-five to fifty c.c. of 1·5% hydrogen peroxide solution, prepared by diluting the commercial 3% peroxide with an equal volume of water and neutralising with $N/10$-sodium hydroxide, are then added, and the mixture is shaken until the red colour of the gas disappears. After five minutes, the bottle is again shaken, and the solution is then titrated with $N/10$-sodium hydroxide, with methyl-orange as indicator. Percentage nitric oxide =

$$224a/\{v(b-p/760)(273/273+t)\},$$

where a=c.c. of $N/10$-sodium hydroxide, v=volume of the bottle in c.c., b=barometric pressure, p=pressure in the bottle before sampling, and t=temperature of gas. The formula is correct for nitric oxide concentrations up to 3%, where volume change, due to formation of nitrogen peroxide, may be neglected. If the temperature of the gas is much higher than normal temperature, a measured volume of water is added after the hydrogen peroxide. Then percentage nitric oxide=

$$224a/\{(v-v')(b-p-w/760)(273/273+t)+2\cdot24a\},$$

where w=vapour pressure of water at $t°$ and v'=volume of peroxide plus water. W. J. W.

Removal of Nitrates by means of Alcohol. R. SCHNEIDEWIND (*Chem. Met. Eng.*, 1921, **24**, 22).—In analytical processes which require the absence of nitric acid or nitrates their removal may be more conveniently effected by means of ethyl alcohol than by the usual method of boiling down with sulphuric acid. For example, to a solution containing 20 c.c. of nitric acid and 150 c.c. of water, 15 c.c. of sulphuric acid are added, and when nearly boiling 5 c.c. of ethyl alcohol are carefully run in from time to time, until further addition no longer causes an evolution of nitrous fumes. The boiling is then continued to expel the excess of alcohol, and the resulting solution is sufficiently free from nitric acid to give no brown ring test, and not to oxidise hydrogen sulphide. G. F. M.

Volatilisation Losses of Phosphorus during Evaporations of Phosphates with Sulphuric Acid or Fusions with Pyrosulphate. W. F. HILLEBRAND and G. E. F. LUNDELL (*J. Amer. Chem. Soc.*, 1920, **42**, 2609—2615).—No volatilisation losses of phosphorus occur during evaporations of sulphuric acid solutions of phosphates, provided the evaporations are carried on at temperatures below 150° and stopped when fumes appear. Such evaporations are best performed over radiators. Volatilisation losses during evaporation of sulphuric acid solutions of phosphates are occasioned by (i) evaporation to complete expulsion of sulphuric acid, (ii) evaporation at high temperatures, such as 200—260°, and (iii) unduly prolonged evaporation at temperatures above 150°. Evaporations involving only a drop or two of sulphuric acid, such as apply in silica treatments, do not cause measurable losses. Fusions with pyrosulphate in covered crucibles and at a dull red heat result in appreciable losses in the case of secondary phosphates, and may result in slight losses in the case of basic phosphates. Orthophosphoric acid and primary and secondary orthophosphates suffer conversion to pyro- and meta-phosphoric acid or phosphates when evaporated to dryness with sulphuric acid or fused with pyrosulphate; such "converted" compounds must be subjected to re-conversion treatments before precipitation with molybdic acid or magnesia mixture. J. F. S.

General Method for the Detection and Estimation of Arsenic. ÉMILE KOHN-ABREST (*Compt. rend.*, 1920, **171**, 1179—1182).—The organic matter (animal organs, physiological fluids, or foodstuffs) is calcined with a mixture of magnesium oxide and magnesium nitrate, using 35 c.c. of a 20% solution of magnesium nitrate and 1 gram of magnesium oxide, the mixture being first dried at 110° (compare Gautier and Clausmann, A., 1917, ii, 421). After calcining, the residue is extracted with dilute sulphuric acid and the extract is transferred to a Marsh's apparatus for the estimation. As an alternative the ash is extracted with dilute hydrochloric acid, the extract being heated on a water-bath with potassium iodide, and the iodine liberated titrated with a standard thiosulphate solution. The liquid is then made alkaline with sodium hydrogen carbonate, and the arsenite present is titrated with standard iodine solution. The second titration gives a measure of the arsenic present. W. G.

Estimation of Arsenic in Neosalvarsan [Salvarsan, etc.]. A. KIRCHER and F. VON RUPPERT (*Ber. Deut. pharm. Ges.*, 1920, **30**, 419—421).—From 0·2 to 0·3 gram of salvarsan (or its derivatives) is boiled with 20 c.c. of sulphuric acid and 15 grams of potassium sulphate in a 500 c.c. round flask fitted with a tube preferably ground in at the neck, and bent downwards to terminate in a bulb absorption tube containing a little water. When all the organic matter has been destroyed, the absorption bulb and tube are rinsed out into the flask and the liquid is diluted to about 250 c.c, boiled for five minutes to expel sulphur dioxide, partly neutralised with sodium hydroxide, and dilute iodine solution added drop by drop in presence of starch to oxidise the last traces of sulphur dioxide. The solution is then decolorised with a few drops of thiosulphate, and after saturation with powdered sodium hydrogen carbonate, the arsenious oxide is titrated with $N/10$-iodine (1 c.c. = 0·003748 gram As). It is advisable to perform a blank experiment at the same time as a check on the purity of the reagents G. F. M.

[Estimation of Arsenic Trihydride.] H. THOMS and L. HESS (*Ber. Deut. pharm. Ges.*, 1920, **30**, 483—489).—See this vol., ii, 110.

Estimation of Arsenic and Phosphoric Acids in the Presence of Large Amounts of Salts. VI. Applications. L. DEBOURDEAUX (*Bull. Sci. Pharmacol.*, 1920, **27**, 424—435. Compare A., 1920, ii, 770).—*Estimation in the Presence of Alkali and Alkaline-earth Chlorides.*—When 3% or more of alkaline-earth chlorides are present, the solution is rendered neutral to phenolphthalein by cold sodium hydroxide solution (D 1·3), the precipitate is filtered, and washed with a solution of barium, strontium, or calcium nitrate (depending on which of these alkaline earths is present in the precipitate) (200 c.c. of a 5% solution, plus 6·5 c.c.,

7·5 c.c., or 5 c.c. respectively of sodium hydroxide solution [D 1·3], the whole being made to a litre with water). The precipitate is dissolved in nitric acid, occluded chlorides are precipitated by silver nitrate, and the phosphoric and arsenic acids in the filtrate are precipitated by an excess of silver nitrate, as described previously (*loc. cit.*). Errors of +0·03 to +0·30% are reported. When alkali chlorides are present in excess, the neutralised solution is treated with sufficient 5% barium nitrate solution to precipitate the arsenic and phosphoric acids as the tribasic salts, together with an excess equivalent to 15 grams of hydrated barium hydroxide per litre; sodium hydroxide (D 1·3), equivalent to one-thirtieth of the barium nitrate used, is also added. The precipitation is effected on a boiling-water bath during one hour. After being cooled, the precipitate is collected, washed with the barium nitrate solution described above, and the estimation completed as usual.

Estimation in the Presence of Ammonium Chloride.—The solution of sodium arsenate or phosphate containing ammonium chloride is treated on a water-bath with an excess of nitric acid, and then evaporated to dryness. The residue is dissolved in a little water and nitric acid, traces of sulphuric acid and hydrochloric acid are removed by barium nitrate and silver nitrate, and the arsenic or phosphoric acid in the filtrate is estimated as described, the error being +0·01 to +0·18%.

Estimation in the Presence of Mixtures of Sulphates and Alkali Chlorides.—Sulphuric acid (D 1·8) sufficient to liberate the chlorine as hydrochloric acid is added, and then as many c.c. of nitric acid (D 1·4) as are equal to one and a-half times the weight of the sulphuric acid used, the solution is evaporated to dryness, and then again with nitric acid to expel all the hydrochloric acid, and the estimation is made with the residue as described above.

Estimation in the Presence of Chromates.—Five % calcium nitrate solution is added sufficient to precipitate the arsenic or phosphoric acid as the tribasic salt, and an excess equivalent to saturation with calcium hydroxide; sodium hydroxide solution is then added equivalent to one-thirtieth of the calcium nitrate solution used. The mixture is diluted to 1500 c.c., heated on the water-bath for one hour, and filtered hot; the precipitate is washed with the alkaline calcium nitrate solution described above, returned to the precipitation flask, dissolved in 1200 c.c. of water and 20 c.c. of nitric acid, and reprecipitated by the alkaline calcium nitrate solution, this procedure being repeated until the precipitate is white and the mother liquor gives but a faint reaction of a chromate. The arsenic or phosphoric acid in the precipitate is then estimated as usual, with an error of +0·11 to +0·22%. CHEMICAL ABSTRACTS.

New Micro-combustion Furnace for Carbon, Hydrogen, and Nitrogen Estimations. W. DAUTWITZ (*Chem. Zeit.*, 1920, **44**, 963).—The apparatus, including absorption stands, is mounted on a board covered with "Eternite," and is movable as a whole. The combustion tube, which is of the dimensions recommended by

Pregl, is heated from the sides by gas jets from two parallel gas tubes situated on either side of and slightly below it. These tubes are supplied with gas from three Bunsen burners which are fixed to the board and so constructed as to support the furnace. The part of the combustion tube containing the packing rests on an asbestos trough, and is covered by a chamber with a slot at the top for the escape of furnace gases. The number of gas jets in use can be controlled at will by means of a special tap. The apparatus can be used for the estimation of nitrogen as well as for ordinary combustions. J. H. L.

An Aid in the Estimation of Silica. S. R. SCHOLES (*Chem. Analyst*, 1920, **29**, 22—23).—A small amount of methyl-orange is added to the acid liquid before evaporation. This serves as an indicator to ensure acidity, and dyes the gelatinous solid as it separates from the solution. Every particle becomes coloured, and is less likely to be lost. CHEMICAL ABSTRACTS.

Potassium Hydrogen Oxalate as a Standardiser in Alkalimetry. YÛKICHI ÔSAKA and KINJI ANDÔ (*J. Tokyo Chem. Soc.*, 1920, **41**, 945—951).—Potassium hydrogen oxalate is used conveniently as a standardiser in alkalimetry, and can be easily prepared by dissolving 86 grams of crystallised normal oxalate and 57 grams of oxalic acid in 500 grams of water. The solution is allowed to crystallise at 25—60° for forty-eight hours, the crystals filtered with the aid of suction, and washed three times with 50 c.c. of water at 50°. K. K.

Estimation of Potassium by the Lindo-Gladding Method. H. C. MOORE and R. D. CALDWELL (*J. Ind. Eng. Chem.*, 1920, **12**, 1188—1189).—In the presence of sodium salts, low results are obtained when the potassium platinichloride is washed with 80% alcohol, although potassium platinichloride is equally insoluble in 80% and 95% alcohol. The deficiency appears to be due to the solvent action of sodium salts in alcoholic solution, and not to the lower strength of the alcohol itself. W. P. S.

Analysis of Leucites and Leucitic Minerals. G. TOMMASI (*Ann. R. Staz. Agrar. sperim.*, 1917—1919, II, **9**, 95—106).—The author describes a method for the estimation of potassium in leucites and rich leucitic minerals, the mineral being first brought into solution by treatment with hydrochloric and nitric acids. [See also *J. Soc. Chem. Ind.*, 1921, February.] T. H. P.

The Estimation of Calcium in the Presence of Phosphates. J. F. BREAZEALE (*J. Assoc. Off. Agric. Chem.*, 1920, **4**, 124—134).—For the estimation of calcium in material, such as plant ash, if manganese is absent, the ash is dissolved in dilute hydrochloric acid, the solution boiled, and made slightly alkaline with ammonia. A saturated solution of oxalic acid is then added until the liquid is just acid. This acid will dissolve the phosphates

of iron and magnesium, and convert the calcium phosphate into calcium oxalate. The solution is again made alkaline with ammonia, and then just acid with oxalic acid. The calcium oxalate is collected in the usual way, and the calcium is estimated either gravimetrically or volumetrically. If manganese is present, it will be precipitated as oxalate along with the calcium oxalate. In this case, the precipitate, after being collected and washed, is dissolved in excess of hydrochloric acid, the solution is made alkaline with ammonia, and a little ammonium oxalate is added. The calcium is precipitated as oxalate, whilst the manganese remains in solution.

Calcium oxalate is not soluble in oxalic acid solution at the ordinary temperature, but is appreciably soluble in boiling 30% acid. It is not soluble in solutions of ammonium or sodium salts in the presence of oxalic acid, but it is markedly soluble in solutions of sodium nitrate, chloride, or sulphate alone at the ordinary temperature, and still more so in their boiling solutions. W. G.

Stabilisation and Standardisation of Thiosulphate Solution for the Copper Assay. A. H. Low (*Chem. Analyst*, 1920, **30**, 18—19).—The standard solution will keep almost indefinitely if stored in amber-glass bottles and treated with about 5 grams of sodium hydroxide per litre to neutralise any carbonic acid present. It is standardised against the ordinary permanganate solution (the iron value × 1·139 = the copper value). About 35 c.c. of the permanganate solution are added to 150 c.c. of water, 5 c.c. of glacial acetic acid, and 6 c.c. of 50% potassium iodide solution, the liberated iodine is titrated with the thiosulphate solution until the colour is faint, starch and 2 c.c. of silver nitrate solution (about 4 grams per litre) are added, and the titration is completed. The yellow colour of the silver iodide produced destroys the purple tinge of the mixture, and the delicacy of the end-point is thus enhanced.

This method of standardisation is rapid, and is recommended as being possibly more accurate than that based on the use of metallic copper. CHEMICAL ABSTRACTS.

Iodometric Estimation of Copper. PETER KLASON (*Svensk. Kem. Tidskrift*, 1919, **31**, 211—220).—The iodometric methods of estimating copper have been critically examined with the view of using one for the estimation of sugars after reduction by Fehling's solution. Moser's results are confirmed (A., 1905, ii, 64). Low's method is inaccurate, because (1) the nitrite, which is not completely removed, causes interference; (2) the acetic acid used is insufficient to decompose the complex copper compounds formed; and (3) the presence of ammonium acetate interferes with the titration. The following modification gives good results. The copper solution, containing hydrochloric acid and nitrite, is neutralised with concentrated ammonia until the colour has passed through yellow and brown to blue. The brown colour is restored by adding 2 c.c. of acetic acid, the volume of the solution is reduced

to 6 c.c. by boiling, 50% potassium iodide is added, and then water, so that the solution contains not less than 100 mg. of copper in 30 c.c., and the solution is then titrated with thiosulphate. In eight experiments, the largest difference between the volume of copper solution used and the titration is 0·08 c.c.

CHEMICAL ABSTRACTS.

Volumetric Estimation of Mercury. A. H. LOW (*Chem. Analyst*, 1920, **29**, 13—14).—The mercury is precipitated as the sulphide, the well-washed precipitate is rinsed with as little hot water as possible into a flask, boiled with 5—6 c.c. of concentrated sulphuric acid and not more than 0·5 gram of solid potassium permanganate until the mixture fumes strongly, the heating is discontinued, and solid oxalic acid is added slowly until the manganese dioxide has disappeared. The mixture is again heated until it fumes strongly, and diluted, after cooling, with about 100 c.c. of water. The solution, which should be quite clear, is treated with the ferric indicator and titrated with $N/10$-thiocyanate (1 c.c. = 0·01 gram of mercury). The method is satisfactory in the absence of chloride or bromide.

If the sulphide stain on the filter paper is worth recovery, the wet paper is warmed on a watch-glass with solid permanganate and dilute sulphuric acid (1:1), and the soluble mercury salt rinsed into the flask containing the balance of the sulphide. The filter paper should now be quite clean after treatment with oxalic and sulphuric acids.

CHEMICAL ABSTRACTS.

Estimation of Mercury in the Brain. HANS HUSGEN (*Biochem. Zeitsch.*, 1920, **112**, 1—22).—See this vol., i, 145.

Detection of Manganese in Presence of Phosphates. TH. SABALITSCHKA and W. ERDMANN (*Ber. Deut. pharm. Ges.*, 1920, **30**, 443—445. Compare A., 1920, ii, 334, 389, 774, 775). —A further criticism of Schmidt's method (*loc. cit.*). In presence of an excess of barium phosphate, manganese is completely precipitated as phosphate by excess of ammonia, and in the further examination of the precipitate, after removal of the phosphoric acid, a flocculent precipitate of manganese oxalate is obtained with ammonium oxalate, which is very liable to be mistaken for calcium. In presence of calcium phosphate, some of the manganese is precipitated in a similar way by ammonia, whilst the rest remains in solution with the zinc in the normal fashion. It is further pointed out that only by leading hydrogen sulphide into the ammoniacal solution, and not by the simple addition of ammonium sulphide, is manganese precipitated entirely as sulphide from its solutions in presence of phosphates or oxalates.

G. F. M.

The Precipitation of Tin by Iron. N. BOUMAN (*Rec. trav. chim.*, 1920, **39**, 711—714. Compare A., 1920, ii, 547).—A reply to Kolthoff (A., 1920, ii, 763), in which the author presents certain new experiments in support of his views.

W. G.

Gravimetric Estimation of Bismuth as Phosphate and its Application to the Analysis of Ores. W. R. SCHOELLER and E. F. WATERHOUSE (*Analyst*, 1920, **45**, 435—439).—The cold nitric acid solution of the bismuth salt (which should be free from chloride) is treated with ammonia until a slight permanent precipitate is formed; 2 c.c. of concentrated nitric acid are then added, the mixture is boiled, and 10% diammonium phosphate solution is added slowly, about 60 c.c. of this solution being required for 0·4 to 0·5 gram of bismuth. The mixture is diluted with boiling water to 400 c.c., the precipitate collected after fifteen minutes, washed with hot 3% ammonium nitrate solution containing a few drops of nitric acid per litre, dried, and ignited at a low temperature. The weight of the precipitate is multiplied by 0·6965 to obtain the amount of bismuth. A process for the estimation of bismuth in ores is also described in detail; in this method, the bismuth is precipitated by treating the hydrochloric acid solution with iron wire; copper, arsenic, and antimony are removed subsequently by extracting the mixed sulphides with sodium cyanide and sulphide solution, and the bismuth is then converted into phosphate and weighed as such. W. P. S.

The Volumetric Estimation of the Methoxyl Group. J. TROEGER and E. TIEBE (*Arch. Pharm.*, 1920, **258**, 277—287).—The demethylation of cusparine by means of dry hydrogen chloride (Troeger and Müller, A., 1915, i, 447) is quantitative in respect both of the pyrocusparine and of the methyl chloride produced. Experiments have therefore been performed to ascertain how far this method may be generalised. The material (0·1 gram), in a boat, is placed in a tube surrounded by a mantle, fitted with an observation window and a thermometer. Air having been displaced by dry hydrogen chloride, the apparatus is heated until bubbles of gas are seen to be escaping from the substance. The methyl chloride so produced is collected in a nitrometer, most suitably over 30—35% sodium hydroxide solution, which only absorbs 0·3 c.c. of the gas per hour, as against 7·0 c.c. by water. In order to conserve the alkali, a T-piece is fitted between the decomposition tube and the nitrometer, through which the gas used to displace air is allowed to escape. It is unnecessary to correct for the vapour tension of water, but allowance must be made for absorption of the gas, as just indicated, and for the presence of air, which originates from the concentrated acid used to generate the hydrogen chloride. This is determined as the unabsorbed residue when the gas collected is transferred to a eudiometer over water. The results obtained with a number of alkaloids, whilst not absolutely accurate, gave a clear indication as to the number of methoxyl groups present, but with compounds, for example, anisic acid, which volatilise below the temperature necessary, the results are, naturally, valueless Whilst the Zeisel method is not applicable to compounds containing sulphur, the present method gives an approximate value in the case of galipinesulphonic acid, although not in another instance. J. K.

Tables giving Alcoholic Strength from the Specific Gravity. II. From 25% to 50% of Ethyl Alcohol by Weight. G. Tommasi (*Ann. R. Staz. Chim. Agrar. sperim.*, 1917—1919, II, **9**, 37—74).—The tables given show the percentages of ethyl alcohol by weight and by volume (at 15°), and the number of grams of alcohol in 100 c.c. at 15°, for the specific gravities of aqueous-alcoholic solutions determined at a number of different temperatures ranging from 10°/15° to 25°/15°.

T. H. P.

A Volumetric Method for Estimating several Sugars in the Presence of each other. Th. von Fellenberg (*Mitt. Lebensm. Hyg.*, 1920, **11**, 129—153).—A method applicable to the estimation of raw sugar, invert-sugar, dextrose, maltose, and lactose when three are present in the same solution is proposed. It is based on the action of a weak and a strong inversion and a decomposition with sodium hydroxide of the various sugars present, with subsequent reduction of a copper solution, followed by an iodometric titration of the cuprous oxide formed. For details of calculation and procedure the original must be consulted. Examples of its application to infant foods, fondant filling, commercial glucose, and malt bonbons are given.

Chemical Abstracts.

Detection of Formic Acid in Acetic Acid. M. Polinski (*Chem. Analyst*, 1920, **29**, 4).—Formic acid is easily oxidised by a mixture of sulphuric and chromic acids, which does not attack acetic acid. Twenty c.c. of the sample, containing not more than 6—8% of acetic acid (if it is concentrated, the sample must be diluted with water to prevent reduction of the chromic acid by propionic acid or other impurities), are mixed with 20 c.c. of concentrated sulphuric acid and 2—3 c.c. of 50% chromic acid solution. If formic acid is present, carbon dioxide is evolved and green chromic sulphate formed. Chemical Abstracts.

Naphthalenesulphonic Acids. III. Alternative Method for the Detection of Naphthalene-2 : 7- and -1 : 6-disulphonic Acids. Joseph A. Ambler (*J. Ind. Eng. Chem.*, 1920, **12**, 1194—1195. Compare this vol., ii, 68).—A portion of the acetone-insoluble dry salts of the acids is boiled with 5 c.c. of a mixture of 4 volumes of 95% alcohol and 1 volume of water, the solution is filtered, and the filtrate cooled; the β-naphthylamine salt of the 2:7-disulphonic acid crystallises from the solution. Another portion of the dry salts is covered with water, boiled, and the mixture titrated with $N/1$-sodium hydroxide solution; the mixture is filtered, and the filtrate evaporated to dryness. The dry residue is dissolved in twice as much water as the volume of $N/1$-sodium hydroxide solution used, and the solution treated with an equal volume of concentrated sulphuric acid. The sodium salt of the naphthalene-1:6-disulphonic acid crystallises gradually from the cooled mixture, whilst the 2:7-acid remains in solution.

6 W. P. S.

General and Physical Chemistry.

Determination of the Refraction of Dissolved Substances, particularly Colloidal Substances. ROBERT WINTGEN (*Kolloid Zeitsch.*, 1921, **28**, 5—6).—The author discusses the discrepancy found by Lifschitz and Beck (A., 1920, ii, 205) between their results for the refraction of certain colloidal solutions and those previously published by the author (A., 1915, ii, 751). It is shown that an error in n_L has the greatest effect on the accuracy of the results, and assuming maximum errors for the values of p, d_L, and n_L, the author has calculated the refractions of the colloidal solutions previously measured. The experiments have all been repeated, and a further set of results obtained which agree with previous measurements better than the values calculated on the basis of the maximum errors. J. F. S.

The Series Spectra of the Elements. A Lecture delivered before the German Physical Society, April 27th, 1920. N. BOHR (*Zeitsch. Physik*, 1920, **2**, 423—470).—The author reviews the present state of knowledge concerning the origin of spectral series. The application of the quantum hypothesis to the nuclear conception of the atom, combined with the assumption of a series of stationary conditions of the electronic orbits, has afforded a completely satisfactory explanation of the origin of the hydrogen spectrum. Radiation is emitted when the electron is displaced from one of the assumed stationary orbits to another, and the frequencies and the intensities of the spectral lines calculated are in strict accord with observation. The spectral series of lines of any elements of higher atomic number than hydrogen are all of frequencies v, such that v is given by the relation first advanced by Rydberg and Ritz, namely, $v=f_{K''}(n'')-f_{K'}(n')$, where n' and n'' are whole numbers, and $f_{K''}$ and $f_{K'}$ two functions the limits of which, when n' and n'' are large, are zero. The complete spectrum is derived from this expression by the combination principle of Ritz, every possible combination of $f_{K'}(n')$ and $f_{K''}(n'')$ being substituted in the expression. An explanation of the origin of the principal series, the sharp subordinate series, and the diffuse subordinate series of lines in the case of sodium is advanced by the consideration of a series of stationary conditions of the electronic orbits for which n and k are whole numbers. The assumptions of the theory are supported, not only by the emission spectra of the elements, but by the phenomena of selective absorption, the production of spectra by electronic bombardment of the atoms, and the phenomena of resonance spectra, as investigated by Wood and Strutt in the case of sodium vapour. The production of spectra and of ionisation by electronic impacts, first studied by Franck and Hertz, are in conformity with the assumptions of the

theory. The later work of Davis and Goucher, and similar experiments, afford direct evidence for the reality of the stationary conditions assumed in the theory developed. The author has recently investigated the effects of disturbing forces exerted on the electrons, as these are exhibited by the series of lines emitted by the element, in the case of hydrogen. Examining the effect in the case of the hydrogen atom, a result is obtained for the resultant series of spectral lines corresponding exactly with the result deduced by Epstein and Schwarzschild for the Stark effect in the hydrogen lines. The state of polarisation of the radiation in the Stark effect, as determined by Epstein, is likewise in accord with the deductions of the principle of correspondence. The application of this principle to the intensities of the various components has been studied by Kramers. The author proceeds to the consideration of the effect of a uniform magnetic field on the hydrogen lines, and likewise the effect of a small disturbing centrally symmetrical field of force on the hydrogen spectrum. It is pointed out that in this treatment, the specification of the stationary states does not correspond exactly with that of Sommerfeld, Epstein, and Debye. The effect of external forces on the fine structure of the hydrogen lines results, in general, in the stationary conditions being no longer sharply defined, the lines consequently losing their sharp definition. When the disturbing field is simple in character, this is not so. The mathematical development of the series spectra of the elements other than hydrogen is complicated, owing to the interaction of the various electrons. Reference is made to the work of Sommerfeld and Rubinowicz. Stark has studied a new series of combination spectrum lines, analogous to the combination tones of acoustics, produced by subjecting the radiating atoms to an intense electric field. The spectrum of helium comprises two series of lines, one a series of single lines and the other a series of doublets. The two series arise owing to mutual actions and reactions of the respective electrons in their orbits, whereby the respective orbits are perturbed. These disturbances have been investigated by the author and Kramers. The analytical difficulties become accentuated when atoms of still higher atomic numbers are being considered. J. S. G. T.

The Development of the Röntgen Spectral Series with Increasing Atomic Number. W. KOSSEL (*Zeitsch. Physik*, 1920, **2**, 470—480).—A critical discussion of the nature and origin of the characteristic *K*, *L*, *M*, and *N* *X*-radiation spectra of the elements. In general, the square roots of the respective characteristic frequencies are linearly related to the respective atomic numbers of the elements. These linear relationships, however, exhibit discontinuities corresponding to certain atomic numbers. The discontinuity in the case of the *K*-radiation corresponds with the atomic number 2 (He). In the cases of the *L*- and *M*-radiations, the respective discontinuities correspond with the atomic numbers 11 (Na) and 18 (Ar). The author concludes that in the case of neon, the mechanism of the second innermost

electron, and in the case of argon, the mechanism of the third innermost electron, is the source of the softest radiation.

J. S. G. T.

Influence of an External Field on the Rotation Spectrum. Analogy to the Stark Effect. GERHARD HETTNER (*Zeitsch. Physik,* 1920, **2**, 349—360).—On the assumption that a gaseous molecule possesses an electric moment, the author shows mathematically that, on Bohr's theory, an external electric field should produce a displacement and a multiplication of the spectrum lines due to the rotation of the molecules. The calculated effect should be readily detectable by means of Imes' apparatus in the short-wave ultra-red absorption lines in the cases of hydrogen chloride, bromide, and iodide.

J. S. G. T.

Influence of an Electrical Field on the Fine Structure of the Hydrogen Lines. H. A. KRAMERS (*Zeitsch. Physik,* 1920, **3**, 199—223).—Mainly a theoretical paper, in which the structure of the hydrogen lines is considered from the point of view of the relativistic Stark effect. The components of a given line in a weak electric field are split into one or more sharp, polarised components, which are displaced proportionally to the square of the force. New components thereby appear the intensity of which increases proportionally to the square or higher power of the electrical force. The components remain sharp and polarised with increasing field intensity, and eventually come more and more into the positions of the components demanded by the unrelativistic Stark effect. The distance of these components from the unresolved line increases proportionally with the first power of the field intensity.

J. F. S.

The Regularity in the Stark Effect on the Spectral Lines of Hydrogen and Helium. USABURO YOSHIDA (*Mem. Coll. Sci. Kyoto,* 1920, **4**, 187—199).—A theoretical paper in which results of experiments on the Stark effect on hydrogen and helium lines, recorded in previous papers (A., 1918, ii, 253; 1919, ii, 125, 379), are discussed. Equations are obtained connecting the displacement, in wave number, of a component with the strength of the electric field, the term number of the series, and the integral number of the component. In the case of the hydrogen lines of the Balmer series, the lines H_α, H_β, and H_δ fit the equations well, but in the case of H_γ there is some divergence with a few of the components. In the helium series, agreement between the observed displacements and those calculated from the equations is sometimes good, but there are many gaps in the observed components for some of the lines. It is noteworthy that the equations for both hydrogen and helium series contain the same constant, 0·673, which is nearly equal to that, 0·660, found by Epstein, theoretically, for the Balmer lines (*Physikal. Zeitsch.*, 1916, **17**, 148).

E. H. R.

Spectrum of Chlorine. I. Emission and Absorption Spectra. MASAMICHI KIMURA and MITSUHARU FUKUDA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 155—158).—Using a tube with electrodes of sodium chloride or another metallic chloride, a photographic comparison of the emission and absorption spectra of chlorine was made. The emission band becomes intense as the region where the absorption gets strong is approached; in the yellow to red region, where the gas is very transparent, the band emission is very faint, whereas in the opaque blue to violet region the band emission is very strong. There is thus a general correspondence between the two spectra, though they are not exactly complementary. E. H. R.

Spectrum of Chlorine. II. The Influence of Magnetic Fields on Spectral Lines of Chlorine. MASAMICHI KIMURA and MITSUHARU FUKUDA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 159—161).—The magnetic separation of single lines in the chlorine spectrum was examined, using tubes similar to those employed for examining the bromine spectrum (below) provided with salt electrodes. Photographs were taken with field strengths varying from 2000 to 6000 gauss. The lines examined were $\lambda\lambda$ 4781, 4786, 4794, 4896, 4904, 5078, 5218, 5221, and 5392. All the lines except λ 4786 gave magnetic triplets of wider specific separations than that of a normal triplet. The separation was proportional to the strength of the magnetic field in each case. E. H. R.

Spectroscopic Confirmation of the Isotopes of Chlorine. A. KRATZER (*Zeitsch. Physik*, 1920, **3**, 460—465).—The influence of the mass of the nucleus on the term of the line and band spectra has been theoretically investigated, and it is shown that the isotopes can be differentiated in the part due to the nucleus vibration and in favourable circumstances also in the rotation part. The measurements of the oscillation–rotation bands of hydrogen chloride due to Imes (*Astrophys J.*, 1919, **50**, 251) are in complete accordance with the theory. J. F. S.

Doublets of the *K* Series of the Röntgen Spectra. NILS STENSSON (*Zeitsch. Physik*, 1920, **3**, 60—62).—The doublets of the *K* series of the Röntgen spectra have been measured for the elements from chlorine to copper with the exception of manganese. The values for the frequency difference of $K_{\alpha_1\alpha_2}$ are tabulated and compared with the $\Delta\nu$ values calculated by the Sommerfeld formula (*Ann. Physik*, 1916, [iv], **51**, 1), when it is found that the experimental values are always larger than the calculated values. This divergence is particularly marked in the case of the elements vanadium to nickel. The frequency differences of $K_{\alpha_3\alpha_4}$ are measured, but on account of the faintness of the photographs an accuracy of not greater than 0·1% is obtained. J. F. S.

The Spectrum of Bromine. I. Line and Band Spectra, Lines of Arc and Spark Types, and the Relations between the Lines. MASAMICHI KIMURA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 127—138).—For examining the spectrum of bromine an ordinary

Geisler tube was unsuitable, and a special type of tube was constructed in which metallic bromides were used as electrodes. Silver bromide was the best salt for this purpose, but sodium or potassium bromide was sometimes employed. The colour of the light varied with the vapour pressure and current density. With a very low pressure, the light from the capillary part of the tube was bluish-green and from the wider part chamois-yellow, but with increasing pressures the capillary light became deep pink, whilst a pink glow was diffused from the wider part. The spectra from these different kinds of glow were photographed and the lines tabulated. The intense lines of the blue spectrum lie under λ 4800, but in the pink spectrum they extend over the entire visible range. The strong lines characteristic of the pink spectrum are at λλ 6632, 6560, 6351, 6150, 4478, 4473, but a number of other intense lines in the blue region are common to both blue and pink glows. The spectra of the pink glow from the capillary and wide portions of the tube are not precisely similar, whilst the chamois-yellow glow from the wide tube shows a mixed line and banded spectrum. The banded portion extends from about λ 5000 to λ 6600, and has a fluted appearance similar to that of the iodine banded spectrum. A comparison of the banded spectrum with the absorption spectrum of bromine shows that these do not correspond, but further discussion of this point is reserved until more experiments have been made. The stronger lines in the pink spectrum are considered to be of the arc type, whilst the lines which are enhanced in passing from the pink to the blue glow are of the spark type. The lines of the arc type when plotted according to their frequencies fall into a number of well-marked groups of equal widths, and between pairs of lines in adjacent groups there is found a nearly constant frequency difference. E. H. R.

The Spectrum of Bromine. II. Line Structures and the Zeeman Effect. MASAMICHI KIMURA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 139—149).—The structures of a number of lines in the bromine spectrum were examined, using a 40-plate echelon grating. At least twelve lines between λ 6632 and λ 4674, all of the arc type, were found to have complex structures. The influence of the magnetic field on the complex lines λλ 6632, 6560, 6351, and 6150 was studied. Though all having a similar structure, the lines were not all similarly affected. In all cases satellites were very sensitive to the action of the field. In a strong magnetic field they always gave triplets. The Zeeman effect was also studied on a number of single lines, between λλ 5600 and 4600; they all showed magnetic triplets with wider separation than that of the normal triplet. E. H. R.

The Distribution of Charged Ions in the Path of an Electric Discharge through a Tube containing Bromine Vapour. MASAMICHI KIMURA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 151—153).—Adopting Stark's view that the emission centres of

spectral lines of spark type are doubly or triply charged atomic ions, and that lines of the arc type are emitted by singly charged atomic ions, the distribution of the different kinds of charged ion in the bromine spectra previously described (preceding abstracts) is discussed. E. H. R.

Arc and Spark Lines of Iodine. Masamichi Kimura (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 167—168).—The effect on the spectrum of iodine of constricting a portion of the discharge tube was studied, and it was found that in the light emitted from the constricted portion of the tube, the spark lines were enhanced, whilst those of the arc type were suppressed. The spark lines intensified were those corresponding with $\lambda\lambda$ 5178, 5185, 5199, 5216, 5678, 5690, 5710, 5739, 5950, 6075, whilst those of the arc type suppressed were $\lambda\lambda$ 4862, 4897, 4917, 5119, 5235, 5894, and others. Similar changes of the intensity of distribution in the spectrum were brought about by sending condensed discharges through an iodine tube having no constricted portion. As the discharge became heavy, the maximum intensity was displaced towards the short wave-length side of the spectrum. E. H. R.

Electrical States of Iodine Vapour when Emitting Line and Band Spectra. Komataro Makino (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 169—171).—The emission of line or band spectra by iodine vapour under the influence of an electric discharge depends on the width of the discharge tube and the current density. Using a glow oscilloscope and a falling-plate camera, the instantaneous current strengths in partial discharges emitting the line and band spectra of iodine were compared, and it was found that the current in a partial glow giving the line spectrum is about three times that of the band discharge. Potential gradients in the path of the discharges were also measured, and it was found that the energy required to emit spark lines is five or six times that required for the band spectrum. E. H. R.

Ultra-red Rotation Spectra of the Hydrogen Haloids. A. Kratzer (*Zeitsch. Physik*, 1920, **3**, 289—307).—A theoretical paper in which it is shown that it is probable that the missing line in the centre of the band of the rotation–oscillation bands is due to the quantum spring $1 \longrightarrow 0$ for emission and $0 \longrightarrow 1$ for absorption. The energy of a rotating and simultaneously vibrating molecule is expressed as a general force law between nuclei (unharmonic oscillators) by means of the quantum number of the rotation and vibration. This expression is used to construct a series formula for the ultra-red rotation–oscillation bands. This formula has been tested on the measurements of Imes (*Astrophys. J.*, 1919, **50**, 251) for hydrogen fluoride, chloride, and bromide, and an agreement between theory and experiment is obtained. It is suggested that the quantum spring $1 \longrightarrow 2$ is observed in the oscillations of Imes. The moment of inertia and the distance between the nuclei has been calculated for the hydrogen haloids. J. F. S.

The Einstein Gravitational Displacement in the Case of the Nitrogen Band $\lambda = 3883$ Å.U. in the Sun's Spectrum. L. GREBE and A. BACHEM (*Zeitsch. Physik*, 1920, **2**, 415—422).—The absence of pressure and pole effects in the case of the nitrogen band $\lambda = 3883$ Å.U. makes this band suitable for the investigation of a possible Einstein gravitational effect on the sun's spectrum. A comparison by a Rowland grating of the sun's spectrum with the cyanogen band spectrum yielded results for the displacement in the red end of the spectrum agreeing with those of Schwarzschild, but somewhat greater than those of St. John. These results, in agreement with those of Schwarzschild, St. John, Evershed and Royds, indicate that different lines in the spectrum are differently displaced, a result which is not to be attributed to the existence of a different Doppler effect in the case of the various lines, as these all originate in the same source. The authors, by a microphotometric comparison of the cyanogen band emission spectrum with the sun's absorption spectrum, conclude that nine only of the thirty-six cyanogen lines previously measured are sufficiently free from objection to be used in the present connexion. Employing these nine lines only, the authors obtain the mean value 0·56 km. per sec. as the displacement, compared with the values 0·63 km. per sec. deduced from Schwarzschild's observations, 0·67 km. per sec. deduced from the observations of Evershed and Royds, and the value of 0·32 km. per sec. given by St. John's results, in each case employing only such of the observed lines as are included in the nine free from objection. The authors conclude that the displacement predicted by Einstein is correct, both in magnitude and direction. J. S. G. T.

Conditions for the Excitation of the Mercury Lines. R. SEELIGER (*Zeitsch. Physik*, 1920, **2**, 405—414).—The mercury spectrum comprises a series of triplets, constituted of a principal and two subordinate series, and a series of single lines made up of a principal and two subordinate series. In addition, there are the spark lines 4339 and 4078, and extraneous lines 2847 and 2536. The respective intensities of these lines in the dark column and the luminous glow of the electric discharge between iron electrodes in mercury vapour contained in a discharge tube of uviol glass have been investigated. The results are given in the form of curves showing how the intensities of the lines vary with distance from the cathode at which the intensity is measured. The maximum intensity in the case of the lines of the first triplet subordinate series occurs nearer the cathode than is the case with the second triplet subordinate series. A similar result holds in the case of the first and second subordinate series of single lines. The maxima occur at increasing distances from the cathode in the following order: 1st subordinate series of single lines, 1st subordinate series triplets, 2nd subordinate series of single lines, 2nd subordinate series of triplets, 2536, 2847. This order is the inverse of the order of the critical emission potentials. The lines 4078 and 2536 do not

belong to a combination series. In pure mercury vapour the respective maxima are very sharply defined, and all occur at approximately the same place. J. S. G. T.

Regularities in the Infra-red Spectra of Gases and their Significance. Gerhard Hettner (*Zeitsch. Physik*, 1920, **1**, 345—354).—A theoretical paper, in which the vibration of one atom of any polyatomic molecule is investigated on the assumption that any force is active between the atoms and without the assumption of infinitely small amplitudes. On the basis of the classical theory and also from Planck's second quantum hypothesis, whole number relationships are found for the frequencies of the infra-red absorption bands brought about by these vibrations. The relationships are shown to hold in all cases where they are applicable. In particular, all the red and infra-red bands in the water-vapour spectrum can be explained. J. F. S.

Characteristic Ultra-red Frequencies of Ammonium Salts. O. Reinkober (*Zeitsch. Physik*, 1920, **3**, 1—8)—The reflexion spectra of the short wave-length portion of the ultra-red has been determined for ammonium chloride, bromide, iodide, fluoride, sulphate, and nitrate. In all cases but that of the fluoride, the measurements were made over the range 1 μ—16·5 μ; in the case of the fluoride, on account of its hygroscopic character, only one measurement was made, namely, at 7·0 μ. The substances were compressed to circular plates 37 mm. diam., and illuminated by a Nernst burner. The measurements were made with a Feuss mirror spectrometer fitted with a rock-salt prism and a vacuum thermopile. It is shown that vibrations characteristic of the ammonium radicle occur at 3·2 μ, 5·8 μ, and 7·0 μ. Ammonium nitrate showed, in addition to the hitherto known frequencies of the nitrate radicle, a very weak frequency at 9·7 μ. An accuracy of 0·01 μ is claimed for the measurements. J. F. S.

Absorption Boundaries in the *L* series. G. Hertz (*Zeitsch. Physik*, 1920, **3**, 19—25).—The absorption boundaries in the *L*-series have been determined for the elements cæsium, barium, lanthanum, cerium, praseodymium, and neodymium. The three absorption boundaries are nearly equidistant. When the $\sqrt{\nu/N}$ values are plotted against the atomic numbers, it is found that the new values fall on the same curves as those previously obtained for the heavier elements. The curves for the boundaries A_2 and A_3 are parallel to one another throughout the whole length from U (92) to Cs (55), whilst the A_1 and A_2 curves converge with decreasing atomic number. J. F. S.

Absorption Boundaries of the *L*-series. Adolf Smekal (*Zeitsch. Physik*, 1920, **3**, 243—246).—A theoretical paper in which it is shown that the measurements of the absorption boundaries of the *L*-series spectrum (Hertz, preceding abstract)

confirm the assertion made by the author (*Sitzungsber. Akad. Wiss. Wien*, 1920, **129**, 2*a*) that only three L boundaries exist, and that the Δ doublet is not real. The oft-quoted intersection of the L curves in the $\sqrt{\nu/R}-z$ diagrams are explained by the course of the L absorption boundaries. J. F. S.

Precision Measurements in the *L*-series of the Röntgen Spectra: Elements Tungsten to Copper. ELIS HJALMAR (*Zeitsch. Physik*, 1920, **3**, 262—286).—Measurements of the *L*-series Röntgen spectra have been made for the elements tungsten to copper, with the exception of gallium, thulium-*I*, thulium-*II*, krypton, and xenon. The results are recorded in a number of tables, and then considered theoretically. J. F. S.

Absorption of *X*-rays by Chemical Elements of High Atomic Numbers. WILLIAM DUANE, HUGO FRICKE, and WILHELM STENSTRÖM (*Proc. Nat. Acad. Sci.*, 1920, **6**, 607—612). —The critical absorption wave-length of *X*-rays, which is associated with the *K*-series of emission lines, has been determined for the elements uranium to tungsten. In the experiments, an ionisation spectrometer was used, and an *X*-ray bulb fed by a current of 140,000 volts. The following values for the *K* critical absorption wave-length have been found: tungsten, 1781×10^{-8} cm.; platinum, 1581×10^{-8} cm.; gold, 1532×10^{-8} cm.; mercury, 1491×10^{-8} cm.; thallium, 1448×10^{-8} cm.; lead, 1410×10^{-8} cm.; bismuth, 1372×10^{-8} cm.; thorium, 1131×10^{-8} cm.; and uranium, 1075×10^{-8} cm. The above values are the mean of values obtained in the first-, second-, and third-order spectra. J. F. S.

Use of Photo electric Cells in the Measurement of Light Absorption by Solutions. HANS VON HALBAN and HERIBRANT GEIGEL (*Zeitsch. physikal. Chem.*, 1920, **96**, 214—232). —A method is described whereby the absorption of light by solutions may be determined rapidly and with great accuracy by the use of an alkali metal cell (sodium or potassium). It is shown that, using a constant source of light (nitralamp) and a sodium or potassium photoelectric cell, measurements may be made over the spectrum range 300—570 $\mu\mu$ for sodium and 360—630 $\mu\mu$ for potassium, but these ranges must be somewhat reduced if thick layers of solutions or homogeneous light is employed. It is also shown that this method may be used with advantage for measurements in the ultra-violet down to 253 $\mu\mu$ if a mercury vapour lamp is employed as the source of illumination. It is further shown by means of measurements with solutions of the yellow tetrabenzoylethylene and anthracene that the method may be employed by determining the extinction coefficient of solutions. J. F. S.

Photo-electric Conductivity and Phosphorescence. B. GUDDEN and R. POHL (*Zeitsch. Physik*, 1920, **3**, 98—103).— Using a calcium–sodium–bismuth phosphorescent substance, the

authors have shown that the maximum of phosphorescent excitement found by Lenard is also the maximum of photoelectric conductivity. This result has been obtained by working with very high electric fields, up to 16,000 volt/cm. If the return of electrons to a phosphorescent substance which has been continuously excited is accelerated by light, it is shown that the return of the electrons is reflected in an increased electrical conductivity of the phosphorescent substance. J. F. S.

Density and Specific Rotation of Mixtures of Liquids with One Optically Active Constituent. W. DEUTSCHMANN (*Zeitsch. physikal. Chem.*, 1920, **96**, 428—436).—A theoretical paper, in which it is shown that the specific rotation of mixtures of inactive and active substances may be calculated from the individual rotation values and the composition of the constituents of the mixture, if by composition is understood, not the analytical composition, but the composition as determined by the volume change. Thus from formulæ of the type $\Phi = z_{a_1}\phi_{a_1} + z_{a_2}\phi_{a_2} + z$ the molecular rotation may be calculated, where Φ is the molecular rotation of the mixture, z, z_{a_1} and z_{a_2} the percentage of associated molecules A_mB_n formed as in the equation $mA + nB = A_mB_n$, the percentage of simple molecules A after mixing and the percentage of double molecules after mixing, and ψ, ψ_{a_1} and ψ_{a_2} the molecular rotations of the respective constituents, the molecular species B, whether simple or multiple, being inactive. The formula is tested for mixtures of benzene and turpentine, and good agreement with fact is obtained. J. F. S.

Influence of Temperature on Photochemical Processes. XII. J. PLOTNIKOW (*Zeitsch. wiss. Photochem*, 1920, **20**, 125—139). —A theoretical paper in which the temperature-coefficient of photochemical processes is discussed. It is shown that the non-illuminated reactions have temperature-coefficients which increase with decreasing temperature and approach unity at very high temperatures. Photochemical reactions may be arranged in three groups with temperature-coefficients, 1·03±0·03, 1·20±0·03, and 1·40 ±0·03 respectively. The first group (TC=1·03±0·03) includes among other reactions, anthracene polymerisation, decomposition of sodium hypochlorite, and the reactions of the photographic plate, the second group (TC=1·20±0·03) the decomposition of ozone in the presence of chlorine, and the third group is made up chiefly of reactions in which one of the halogens plays an important part. The author considers that the temperature-coefficient is a characteristic constant of photochemical reactions. The three groups may in all probability be reduced to two, since the second, 1·20±0·03, is the same as the temperature-coefficient of diffusion, and the reactions to which this coefficient applies are for the most part gaseous. The influence of the wave-length of the light on the coefficient is considered, and it is shown that in the case of photographic plates the temperature-coefficient with white light is 1·06, with plates

sensitised with pinachrome for blue light $\lambda = 436\ \mu\mu$, $TC = 1{\cdot}04$, for yellow light $\lambda = 579\ \mu\mu$, $TC = 1{\cdot}08$, and for green light $\lambda = 546\ \mu\mu$, $TC = 1{\cdot}08$. For plates which have been exposed to very subdued light, the temperature-coefficient for blue light is 1·03, yellow light 1·04, and green light 1·04. J. F. S.

The Action of Light on Sparingly Soluble Oxides in Solutions of Silver Salts. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1920, **114**, 151—152).—When ignited zinc oxide is left in a solution of silver nitrate or silver sulphate in subdued light, it remains white for a whole day, but in bright light it quickly becomes grey, and, after a quarter of an hour, black. Lead oxide (litharge) blackens in the same manner, even in subdued light, but less rapidly than in sunlight, and ferric oxide, bismuth oxide, Bi_2O_3, antimonic oxide, and yellow mercuric oxide change in colour more slowly. The blackening is due to the deposition of silver oxide. An ionic exchange appears to take place at the surface of the oxide, controlled, probably, by the electric potentials of the reacting substances. The velocity of the reaction depends on the tendency of the silver oxide to crystallise in the lattice form appropriate to the medium in which the deposition takes place. E. H. R.

Reduction of Sodium Silver Thiosulphate by Hyposulphite. II. ALBERT STEIGMANN (*Kolloid Zeitsch.*, 1921, **28**, 29—31. Compare this vol., ii, 13).—A discussion of the physical development of the latent photographic image by sodium hyposulphite in plates and papers after they have been fixed. The silver required for the development is obtained from the silver sodium thiosulphate of the fixing bath. J. F. S.

Photo-chemistry of Tetra-benzoylethylene. I. HANS VON HALBAN and HERIBRANT GEIGEL (*Zeitsch. physikal. Chem.*, 1920, **96**, 233—250).—The colour changes which tetrabenzoylethylene undergoes under the influence of light have been investigated. It is shown that the conversion of colourless tetrabenzoylethylene into a yellow compound by the action of light is not reversible. If the yellow compound is kept in the dark, it again becomes colourless, but will not then take on the yellow colour if it is again subjected to light. In light, a rapid decolorisation is superimposed on the decolorisation in the dark, by which the same product is in all probability formed. The processes may be represented by the scheme:

$$\underset{\text{Colourless.}}{A} \xrightarrow{\text{light}} \underset{\text{Yellow.}}{B} \xrightarrow[\text{light}]{\text{dark and}} \text{Colourless.}$$

The substance B was isolated, and found to have the same molecular weight as A. The absorption spectra of A, B, and C have been photographed, and that of B determined by means of the photoelectric cell previously described (this vol., ii, 145). The

absorption spectra were examined in alcoholic solution; *A* and *C* exhibit no marked absorption in the visible region, whilst *B* has an absorption maximum in the blue. The molecular extinction coefficient of *B* is found to be $1{\cdot}813 \times 10^4$. The course of the decolorisation, both in light and in the dark, was followed by means of a photoelectric cell, and it is shown that the dark reaction is of the first order. Its velocity depends markedly on the solvent, and is increased by the presence of acids. Oxygen retards the light reaction, but is without influence on the dark reaction. The velocity of formation of *B* in light is uninfluenced by the presence of oxygen. The reaction $B \longrightarrow C$ under the conditions of the present experiments is also unimolecular, and it has a very much greater velocity when subjected to even a weak illumination than the dark reaction. J. F. S.

Direct Determination of the Range of α-Rays in Solids. H. RAUSCH VON TRAUBENBERG (*Zeitsch. Physik*, 1920, **2**, 268—276).—A small-angled wedge of the solid was arranged with its lower face parallel to, and at a few millimetres distant from, a plane surface activated by means of radium-*C*. The upper face of the wedge was in contact with a zinc sulphide phosphorescent screen. The range of the α-rays in the solid was determined by observing the distance of the line of demarcation between the light and dark regions of the screen from the angle of the wedge. Correction was made for the thickness of air between the lower face of the wedge and the source of α-radiation. The effect of β-radiation was eliminated by placing the apparatus between the poles of a powerful magnet. The following results were obtained for the respective ranges expressed in 10^{-4} cm. in the various elements stated: lithium, 129·1; magnesium, 57·8; aluminium, 40·6; calcium, 78·8; iron, 18 7; nickel, 18·4; copper, 18·3; zinc, 22·8; silver, 19·2; cadmium, 24·2; tin, 29·4; platinum, 12·8; gold, 14·0; thallium, 23·3; lead, 24·1. The experimental results can be correlated with the atomic numbers of the respective elements by the formula

$$R_s = \sqrt[2]{A_s/d_s} \,.\, \sqrt[2]{Z_s/A_s} \,.\, \sqrt[2]{A_N/Z_N} \,.\, d_N / \sqrt[2]{A_N} \,.\, R_N,$$

where R_s, A_s, d_s, and Z_s are respectively the range, atomic weight, density, and atomic number of the substance, the subscript N referring to the corresponding physical constants in the case of hydrogen, for which Taylor's value of $R_N = 30{\cdot}9$ cm. at 15° and 760 mm. is employed. The results in the cases of helium and lithium do not satisfy this relation. It is surmised that these anomalies may originate in the production of secondary α-radiation, due to impact of the primary α-radiation. J. S. G. T.

Application of the Displacement Rule to the Case of Substances Emitting Simultaneously both α- and β-Rays. OTTO HAHN and LISE MEITNER (*Zeitsch. Physik*, 1920, **2**, 60—70). —Radium emits both α- and β-radiations. The application of the displacement rule for the atomic weight of the resulting transforma-

tion products, indicates that these should comprise 92% of radium emanation due to the emission of α-radiation, and 8% of a tervalent isotope of actinium arising from the emission of β-radiation. In the case of radio-actinium, the emission of β-radiation should result in the conversion of 13% of the transformed radio-actinium into a quinquevalent isotope of proto-actinium. A search for such transformation products arising from the emission of β-radiation in the case of radium and radio-actinium led in each case to a negative result—no trace of such anticipated transformation products being obtained in either case. The authors are unable to advance any satisfactory explanation of these negative results, but suggest the possibility of the quick-moving β-rays originating in a secondary manner by the transportation of energy to the electrons by the α-rays, and not having a H nucleus attached to them. J. S. G. T.

Relationship of the Actinium Series Branch of the Uranium-Radium Series. ADOLF SMEKAL (*Physikal. Zeitsch.*, 1921, **22**, 48—51).—A theoretical paper in which the disintegration of Ur-II is considered. The author makes the assumption that in the disintegration of Ur-II to form Ur-*Y*, an X_3 particle is emitted, whilst an α-particle is emitted in the disintegration to ionium. This involves the further hypothesis that the nucleus of Ur-II is made up of fifty-seven α-particles and two X_3-particles. On the basis of these hypotheses the author deduces the fraction of the Ur-II disintegration which goes to form the actinium series, and finds a value 3·4%, which falls between the most recent values 3·0—4·2%. Radio-actinium furnishes a quantitative proof of the possibility of the existence of radioactive X_3-rays. J. F. S.

The Enumeration and Range of the Recoil Atoms of Thorium-*C* and Thorium-*C*′. WERNER KOLHÖRSTER (*Zeitsch. Physik*, 1920, **2**, 257—263).—A slightly modified form of the apparatus embodying the point discharge, employed by Geiger (A., 1913, ii, 745) and Kovarik and McMeehan (A., 1915, ii, 605) for counting α- and β-particles, was employed to determine the number and range of recoil atoms of thorium-*C* and thorium-*C*′. Aluminium foil, activated for twelve hours at low tension by a mesothorium preparation, served as source of the radiation. The recoil atoms were counted in hydrogen for pressures between 4 mm. and 74 mm. of mercury. The resultant curve in which the numbers of recoil atoms are plotted as ordinates against the appropriate pressures as abscissæ is made up of a number of horizontal portions corresponding with the respective numbers of recoil atoms, 0, 60, and 100, joined by very steep portions corresponding with respective pressures of 61 mm. and 35 mm. of mercury. Two kinds of recoil atoms appear at these pressures. These correspond with the α-radiation of thorium-*C*′ and thorium-*C* respectively, in agreement with the relative proportions of thorium-*C*′ and thorium-*C* present in the active preparation It is concluded that a recoil atom results from each atom of thorium-*C* and thorium-*C*′ transformed by the emis-

sion of an α-ray. The respective ranges of recoil were determined by employing various distances between the active preparation and the discharge point of the counting device, the pressure in the apparatus being suitably adjusted so that the recoil was registered. In this manner the average range of recoil in hydrogen at 15° and 760 mm. was found to be $0·55_8$ mm. in the case of thorium-*C* and $0·96_8$ mm. in the case of thorium-*C′*. The corresponding ranges in air at 15° and 760 mm. are $0·12_9$ mm. and $0·22_4$ mm. J. S. G. T.

Radioactive Facts and Nuclear Structure. GERHARD KIRSCH (*Physikal. Zeitsch.*, 1921, **22**, 20—23).—In a previous paper (A., 1920, ii, 577) the author showed that the atomic nucleus consisted chiefly of some fifty α-particles and some twenty binding electrons, to which in the radium and actinium series several H particles have to be added. The present paper is a continuation of the discussion applied to the several radioactive series. J. F. S.

Potential of Excitation of Helium. J. FRANCK and P. KNIPPING (*Zeitsch. Physik*, 1920, **1**, 320—332. Compare A., 1920, ii, 20; Horton and Davies, A., 1919, ii, 210).—The resonance and ionisation potentials of pure helium have been determined, and it is shown that two resonance potentials exist at the values 0·8 volt removed from one another, a result which is demanded by the two series spectra of helium. The potential curve shows calculated breaks at 20·45, 21·25, 21·85, 23·7, and 25·3 volts, whilst the experimental curve has breaks at 20·45, 21·25, 21·9, 23·6, and 25·3 volts. The point 20·45 does not show until a little gaseous impurity is allowed to mix with the helium, but it is held that the break is due to the helium, and not to the impurity. J. F. S.

The Properties of Protoactinium. II. Life Period and Content in Uranium Minerals. OTTO HAHN and LISE MEITNER (*Ber.*, 1921, **54**, [*B*], 69—77. Compare A., 1919, ii, 209; 1920, ii, 147).—It has been shown previously that only 3% of the atoms of uranium disintegrating pass through the protoactinium, actinium series, but the period of average life of protoactinium could only be fixed within the limits of 1200 and 180,000 years. By separation of the protoactinium from uranium salts of approximately known age (three preparations, one of the nitrate at least twenty years old, the second of the nitrate at least fifty-two years old, and the third consisting of a mixture of yellow uranium oxide and uranium acetate, each about sixty years old), and measurement of its activity in comparison with that of uranium, it has been found possible to estimate the half-life period of protoactinium, the mean of three concordant experments being about 12,000 years. This value is to be regarded as the lower limit. From this datum and the known disintegration ratio of the actinium series to the uranium series it is possible to calculate the protoactinium content of uranium minerals. It is thus found that one ton of uranium in any uranium mineral contains 72 mg. of protoactinium; the corresponding figure for radium is 330 mgm. H. W.

Spray-electricity of Solutions of Electrolytes. H. Zwaardemaker and H. Zeehuisen (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 658—662).—A continuation of previous work in which it was attempted to correlate the odour of different organic substances with the positive electric charge developed when an aqueous solution of the substance is sprayed (compare A., 1918, ii, 351). Inorganic acids and bases appear not to develop any charge when sprayed, at any concentration, with the possible exception of hydrochloric acid. Among organic acids are found some, including benzoic, salicylic, lactic, and the fatty acids, which in concentrated solutions give a positive charge and in weaker solutions a negative charge, with a zero transition point at a definite concentration. These phenomena can be explained on the hypothesis that the positive charge of the spray is due to whole molecules, whilst the negative charge is due to the dissociated anions which lie nearest the surface of the droplets composing the spray. Concentrated solutions of some inorganic salts when sprayed have a slight, though distinct, negative charge, whilst others do not give any charge. E. H. R.

Thermal and Electrical Conductivity of Lithium between 20° and 373° Absolute. Walther Meissner (*Zeitsch. Physik*, 1920, **2**, 373—379).—Determinations were made of the thermal and electrical conductivities of two rods of lithium, about 5 cm. long and 0·5 mm. diameter, the one being employed between 56° and $-193°$ and the other between 100° and $-250°$. A modified form of the apparatus previously employed by the author was employed, precautions being taken to maintain the surface of the metal untarnished during the course of the determinations, and to secure good electrical connexions between the metal and the leads. Samples of lithium supplied by Kahlbaum were employed. It is recognised that they contained perceptible impurities. The temperature-coefficient between 0° and 100° was found to be practically constant and equal to $4·35 \times 10^{-3}$. The corresponding values of the temperature-coefficients between 273° and 90·9°, 80·14°, 20·42° absolute were found to be respectively $4·21 \times 10^{-3}$, $3·85 \times 10^{-3}$, and $0·25 \times 10^{-3}$. The value of the quotient of the thermal conductivity by the product of electrical conductivity and the absolute temperature increased from $2·29 \times 10^{-8}$ at 19·75° to $2·64 \times 10^{-8}$ at 101·26°. The corresponding values at 90·90° and 20·42° absolute were $1·34 \times 10^{-8}$ and $0·63 \times 10^{-8}$. The absolute value of the specific electrical conductivity at 0° could not be determined owing to the irregular form of the specimens employed, but calculated values agreed within 10% with the value $11·7 \times 10^{-4}$ ohm^{-1} cm.$^{-1}$ given by Guntz and Broniewski (A., 1909, ii, 113). Using this value, the observations lead to the value 0·17 (grm. cm. deg. sec.)$^{-1}$ for the thermal conductivity of lithium at 0°. A comparison of the value of the temperature-coefficient of resistance obtained in the research with those of Guntz and Broniewski leads the author to conclude

that the specimens of lithium employed were of greater purity than that employed by the latter observers. J. S. G. T.

Electrical Conductivity of Solid Mixtures of Salts. A. Benrath and H. Tesche (*Zeitsch. physikal. Chem.*, 1920, **96**, 474—482).—The electrical conductivity of mixtures of lithium chloride and potassium chloride, sodium nitrate and lithium nitrate, lead chloride and stannous chloride, have been measured over a considerable range of temperature and over the whole range of compositions. The results indicate that conductivity isotherms similar to those for alloys do not suffice to represent the results in the case of mixtures of salts. The point at which the eutectic is formed is a well-characterised point in the conductivity isotherms, and if the curves are suitably drawn, they furnish information as to the part played by the individual components in the conductivity. J. F. S.

Recovery of Transmissivity in Passive Iron Wires as a Model of Recovery Processes in Irritable Living Systems. II. Ralph S. Lillie (*J. gen. Physiol.*, 1920, **3**, 129—143. Compare this vol., ii, 80).—Passive iron wires, when activated after prolonged immersion in nitric acid of 55—90 vols. % of acid, D 1·42, revert spontaneously to the passive state after a temporary reaction, which is transmitted rapidly over the whole length of wire. The duration of this reaction at any region decreases rapidly with increase in the concentration above a certain critical limit of 52—54%. In weaker acid, 50% and lower, the reaction continues uninterruptedly until all the metal is dissolved. Immediately after this automatic repassivation, the wire fails to transmit activation through more than a short distance (1—2 cm.); if left undisturbed in the acid, it recovers by degrees its power of transmission, as measured by the distance travelled by an activation wave, at first slowly, then more rapidly; eventually, after an interval varying with the concentration of acid and the temperature, the activation wave is transmitted through an indefinite distance, as before. The return of complete transmissivity in 55% acid occupies less than a minute at 20°; in stronger acid it is more gradual, requiring in 90% acid twenty minutes or more. This "complete recovery time" is nearly proportional to the excess of concentration of acid above the limiting value of 53—54%. In a given solution of acid, the rate of recovery exhibits a temperature-coefficient closely similar to that of most chemical reactions at this temperature, 3 at 20°, and also to that of the rate of recovery (refractory period) of irritable living tissues after stimulation (Q_{10}=about 3). Two definite phases are distinguishable in the recovery process: (i) the re-deposition of the continuous passivating layer of oxide or oxygen compound, and (ii) the progressive change of the newly passivated wire from the state of incomplete to that of complete transmissivity. The former phase is of brief duration, and is indicated by a sudden change in the

electrical potential of the wire from that of active to that of passive iron; this phase is succeeded by the second and more prolonged period, during which the passivating layer undergoes the progressive alteration associated with the recovery of transmissivity. This alteration appears to consist in a progressive thinning of the passivating film until a minimum thickness of probably one molecule is attained. Further thinning is prevented by local electrochemical oxidation. The phenomena of partial or limited transmission during the second phase of the recovery process show a close correspondence with the phenomena of conduction with decrement in irritable living tissues, such as nerve. Other analogies with the behaviour of irritable tissues, such as threshold phenomena, distinction between "local" and "propagated" effects, summation, and effects resembling electrotonus, are described. J. F. S.

Passivity. Researches on Iron and Nickel. C. A. LOBRY DE BRUYN (*Rec. trav. chim.*, 1921, **40**, 30—64).—The first part is a theoretical discussion of passivity based on the theory of Smits and his co-workers (compare A., 1914, ii, 165, 420, 611; 1915, ii, 39, 217; 1916, ii, 77; 1917, ii, 262; 1918, ii, 54).

The author finds for the equilibrium potential of iron in ferrous sulphate solution, when compared against a calomel normal electrode, the value $E_h = -0{\cdot}434$ volt (compare Richards and Behr, A., 1907, ii, 222). He has examined the influence of hydrogen and oxygen, variation in temperature, and presence of ferric ions on the equilibrium potential of iron (*loc. cit.*), and applies these results to a consideration of the passification of iron.

The fact that iron becomes passive in concentrated nitric acid may be attributed to two factors, namely, (i) that in nitric acid the concentration of the electrons is very feeble, and (ii) that activating influences do not make themselves felt.

The cathodic and anodic polarisation of iron is considered, and in the latter case a graph is given showing the variation in the potential of iron in solutions of ferrous sulphate and ferrous chloride, as measured against a calomel electrode at different current densities. In ferrous sulphate solution, when the current density reaches about 0·4 ampere per sq. cm., the electrode suddenly becomes passive, and if the current density is further increased, there is only a feeble further increase in the potential In ferrous chloride solution, this sudden change is not observed, and even at the highest current densities used the electrode remains active.

In the passage into solution from an iron anode, the current yield is practically 100% when the iron is in the active state. When, however, it is in the passive state, the yield is only of the order of 1%, and varies with the sample of iron used. The potential of passive iron during anodic polarisation falls as the temperature rises, and curves are given showing the activation of iron under different conditions after anodic polarisation. W. G.

The Detection of Parts of Different "Nobility" in a Piece of Metal. S. Kyropoulos (*Zeitsch. anorg. Chem.*, 1920, **114**, 157—160).—Different parts of a piece of metal may exhibit different behaviour in certain solutions, on account of differences of electric potential. Thus, when a clean nail is placed in an agar gel containing potassium ferricyanide and phenolphthalein, the metal at the point appears more "noble" than that at the head; in the neighbourhood of the point a red colour develops, on account of the formation of free OH' ions, whilst along the surface of the nail a blue colour appears, due to the production of Fe'' ions. The difference is due to the greater degree of working to which the metal towards the head of the nail has been subjected. If potassium ferrocyanide is substituted for ferricyanide in the solution, it may be used to detect similar local differences in pieces of manganese, zinc, cadmium, aluminium, nickel, or copper. If a clean silver plate is scratched and immersed in an agar solution containing potassium iodide and phenolphthalein, the scratches show up as black lines on a bright ground, through the deposition, on the less "noble" worked parts, of silver iodide. With proper choice of indicators, the method should be generally applicable to the detection of chemical and physical inhomogeneity in the surface of a metal. E. H. R.

The Separation of Gases and the Production of Pressure Differences in the Positive Column in the Electrical Discharge in Rare Gases, and its Explanation on the Basis of Elastic Impacts of Electrons. Application to the Case of Isotopes of the Rare Gases. Franz Skaupy (*Zeitsch. Physik*, 1920, **2**, 213—217).—In a previous paper (A., 1916, ii, 469), the author has pointed out that two gases may be quickly separated when submitted to the effect of the discharge in a long discharge tube supplied with direct current, one gas collecting at the cathode, the other at the anode. The effect was attributed to the different ionisation potentials of the gases and the different tendencies exhibited by the respective neutral atoms to form negative molar ions. Assuming that the electrons moving towards the anode exert an appreciable pressure on the gas, it is shown that, due to impact of the electrons on the atoms of a gaseous mixture, the lighter atoms are more strongly urged thereby towards the anode. In the case of the rare gases, low atomic weight is characterised by high ionisation potential, and the resultant separation arises from the operation of both causes, impact and ionisation effects being both operative. From the point of view of separation originating in the electronic impacts on the atoms, separation of the isotopes of the rare gases should be easily possible. A simple relation is deduced between the pressure gradient in the positive column and the field strength. This takes the form $dp/dx = nXe$, where n is the number of electrons per unit volume, X the field strength, and e the ionic charge. J. S. G. T.

Thermodynamics of Normal Elements. VII. Temperature Formula of the Weston Normal Element and the Solubility Curve of $CdSO_4,\frac{8}{3}H_2O$. ERNST COHEN and J. J. WOLTERS (*Zeitsch. physikal. Chem.*, 1920, **96**, 253—258).—The authors criticise the temperature formula for the Weston normal element which was adopted by the International Conference on Electrical Units and Standards, 1908. This formula has the form $E_t = E_{20} - 0{\cdot}0000406(t-20) - 0{\cdot}00000095(t-20)^2 + 0{\cdot}00000001(t-20)^3$, and gives a maximum *E.M.F.* at $+3°$, which is in keeping with a minimum solubility of $CdSO_4,\frac{8}{3}H_2O$ at $+1°$. This solubility minimum is taken from results of Mylius and Funk (A., 1897, ii, 316). The authors criticise the accuracy of these determinations, and have redetermined the solubility of $CdSO_4,\frac{8}{3}H_2O$ at low temperatures and obtained the following values: $-3{\cdot}00°$, 43·047 grams per 100 grams solution; $-6{\cdot}00°$, 43·020 grams; $-9{\cdot}00°$, 43·008 grams; and $-12{\cdot}00°$, 43·029 grams. This gives a solubility minimum at $-9°$, and this value is in keeping with the temperature formula of Jaeger and Wachsmuth (*Ann. Phys.*, 1902, **9**, 1046), $E_t = E_{20} - 0{\cdot}000038(t-20) - 0{\cdot}00000065(t-20)^2$, which is therefore to be preferred before the formula at present adopted for the change of *E.M.F.* of the Weston normal cell with temperature.

J. F. S.

Thermodynamics of Normal Elements. VIII. ERNST COHEN, W. D. HELDERMAN, and A. L. TH. MOESVELD (*Zeitsch. physikal. Chem.*, 1920, **96**, 259—274. Compare preceding abstract). The various factors necessary for a recalculation of the *E.M.F.* of the Weston cell at 18° have been redetermined with very refined apparatus. Among the data thus obtained are: heat of solution of potassium chloride in 200 molecules of water, -4397 cal. (mean of seven experiments); *E.M.F.* of the cell Cd-amalgam (8% Cd) | $CdSO_4$ solution (2·559%) | Hg_2SO_4Hg; 25°, 1·07175 volt; 20°, 1·07208 volt; 15·0°, 1·07239 volt; and in a second series of measurements: 25°, 1·07170 volt; 20·0°, 1·07202 volt; 15°, 1·07235 volt. These values give the relationship between *E.M.F.* and temperature as $E_t = 1{\cdot}07173 - 0{\cdot}0000645(t-25)$, from which the chemical energy of the combination at 18° is calculated as 50,298 cal. The combination Cd(γ) | $CdSO_4$ solution (2·559%) | Hg_2SO_4Hg has been measured, and the values 25°, 1·12273 volt; 15°, 1·12560 volt; and 20°, 1·12398 volt obtained. The heat change when 1 mol. of $CdSO_4$ dissolves in an unlimited quantity of $CdSO_4$, $440{\cdot}6H_2O$ is calculated to $Q_d = 10{,}627$ cal. The heat of solution of $CdSO_4$ in solutions of $CdSO_4$ of various concentrations at 18° is determined, and the difference between the heats of formation of $CdSO_4$ and Hg_2SO_4 is found to be 45,346 cal. The heat of hydration of anhydrous $CdSO_4$ to form $CdSO_4,\frac{8}{3}H_2O$ is found to be 7890 cal. Using the above data, the chemical energy of the Weston element is found to be 47,427 cal., using the international temperature formula, and

47,447 cal., using Jaeger and Wachsmuth's formula, whilst by the thermochemical method the value of 47,561 cal. is obtained.

J. F. S.

Thermodynamics of Normal Elements. IX. Temperature Formulæ of Normal Elements and the Specific Heat of the Salts contained in these Elements. Ernst Cohen, C. I. Kruisheer, and A. L. Th. Moesveld (*Zeitsch. physikal. Chem.*, 1920, **96**, 437—470. Compare preceding abstracts).—The authors have developed theoretically a temperature formula for the calculation of the *E.M.F.* of the Weston normal cell. This formula has the form:

$$E_t = E_0 + (E_0 + U_0/nFT_0)(T - T_0) - 1/2nFT_0(dU/dT)_0(T - T_0)^2 + 1/6nFT_0[1/T_0(dU/dT)_0 - (d^2U/dT^2)_0](T - T_0)^3 + \ldots$$

This formula is based on the Gibbs-von Helmholtz formula, $E = U/nF + T_0 dE/dT$, and all symbols have their usual significance. The mechanism of the Weston element and data for the evaluation of U_0, $(dU/dT)_0$ and $(d^2U/dT^2)_0$ is obtained. The value of U_0 is found to be 47561 cal. $(dU/dT)_0 = 27{\cdot}10$ cal./degree, 18·64 and 17·44 cal. respectively when the various data available are employed in its calculation. The authors have therefore redetermined this data, and have obtained the following values: specific heat of mercury at 20°, 0·03338; molecular heat at 20°, 6·697; specific heat of $CdSO_4 \frac{8}{3}H_2O$ at 20°, 0·2008; molecular heat at 20°, 51·50; specific heat of mercurous sulphate, 18·5—22·5°, 0·06400; molecular heat, 31·83; specific heat of $ZnSO_4,7H_2O$, 18·5—22·5°, 0·3184; molecular heat, 91·55. Calculating the value of $(dU/dT)_0$ from this data, the figure 22·38 cal./degree is obtained. The data presented indicate that the temperature formula of von Steinwehr (A., 1914, ii, 622) does not represent the facts.

J. F. S.

Electromotive Properties of certain Binary Alloys. III. Electromotive Behaviour of Cadmium-Antimony Alloys. Robert Kremann and Julius Gmachl-Pammer (*Int. Zeitsch. Metal.*, 1920, **12**, 241—245; from *Chem. Zentr.*, 1921, i, 123. Compare this vol., ii, 10, 11).—A series of cells composed of cadmium, normal cadmium sulphate solution, and cadmium–antimony alloys of varying composition has been examined in the manner described previously. The initial and final potential did not exhibit any marked differences. Slowly cooled alloys showed a slight rise in potential (about 20 millivolts nobler than cadmium) at 40 atom. % of antimony, due to the unstable compound, Cd_3Sb_2; this potential increases between 90 and 100 atom. % of antimony to that of the latter metal. Quenched alloys, on the other hand, exhibit a more definite increase in potential (about 150 millivolts) at 50 atom. % of antimony, caused by the stable compound, CdSb; this potential remains practically constant for alloys which do not contain more

than 90% of antimony. The surprising result that the stable equilibrium is set up in quenched, the unstable in slowly cooled, alloys, is confirmed by metallographic investigation. Kurnakov and Konstantinov find that stable equilibria are only attained by seeding or vigorous agitation; quenching is accompanied by violent mechanical shock. H. W.

Electromotive Properties of certain Binary Alloys. IV. Electromotive Behaviour of Alloys of Thallium with Zinc, Lead, Bismuth, Tin, Antimony, and Cadmium. ROBERT KREMANN and ALBERT LOBINGER (*Int. Zeitsch. Metallog.*, 1920, **12**, 246—256; from *Chem. Zentr.*, 1921, i, 123—124. Compare preceding abstract).—In the cells, Zn | *N*-zinc sulphate solution | $Zn_{(1-x)}Tl_x$, the potential of zinc is observed with alloys containing up to about 95 atom. % of thallium; the initial and final potentials are almost identical. In the series, Tl | thallous chloride solution saturated at 15° | $Tl_{(1-x)}Pb_x$, the potentials from 0 to 20 atom % of lead are practically equal to those of thallium; from 50 to 100 atom. % of lead they are equal to the lead potentials; between 20 and 50 atom. % of lead the potentials pass into one another asymptotically. The final values, which are otherwise identical with the initial potentials, show a marked rise in the case of the alloys of very high lead content which is attributed to the formation of layers of oxide. In the series, Tl | thallous chloride solution saturated at 15° | $Tl_{(1-x)}Bi_x$, the initial potential of the alloys diminishes continuously from 0 to 25 atom. % of bismuth in conformity with the equilibrium diagram, then remains almost constant to 58 atom. % of bismuth, subsequently diminishes rapidly to 61 atom. %, and then remains almost constant to pure bismuth. The two compounds, $BiTl_3$ and Bi_5Tl_9, are relatively little less noble than thallium (about 50 and 140 millivolts respectively), and much less noble than bismuth (about 250 and 340 millivolts respectively). The initial potential of the cells, Tl | thallous chloride solution saturated at 15° | $Th_{(1-x)}Sn_x$, remains practically constant from 0 to 90 atm. % of tin, and then falls continuously to the value of the latter metal. Re-examination of the diagram of Kurnakov and Puschin indicates that tin scarcely forms mixed crystals with thallium, whilst the latter only does so with, at the most, 40 atom. % of tin. The thallium potential is shown by the series, Tl | thallous chloride solution saturated at 15° | $Tl_{(1-x)}Sb_x$, to 80 atom. % of antimony; the value then diminishes slowly at first, rapidly with more than 99 atom. % of antimony, to the potential of the latter. Electromotive evidence of the existence of the compound, $SbTl_3$, is not observed. In conformity with the equilibrium diagram, examination of the system Tl | electrolyte | $Cd_{(1-x)}Tl_x$, did not give any indication of the formation of a compound, the potentials corresponding closely with those of tin. Thallous chloride solution saturated at 15° and shaken with cadmium turnings and *N*-cadmium sulphate solution agitated with thallium turnings were used as electrolyte. H. W.

Electromotive Properties of certain Binary Alloys. V. Electromotive Behaviour of Tin-Sodium Alloys. R. KREMANN and JULIUS GMACHL-PAMMER (*Int. Zeitsch. Metal.*, 1920, **12**, 257—262; from *Chem. Zentr.*, 1921, i, 124. Compare preceding abstract).—The authors have investigated the series Sn | 0·1*N*-sodium iodide solution in pyridine | $Sn_xNa_{(1-x)}$ and also in the cases of alloys containing less than 67 atom. % of sodium, the cells Sn | *N*-sodium sulphate solution in water | $Sn_xNa_{(1-x)}$. The existence of four compounds, Na_4Sn, Na_2Sn, NaSn, and $NaSn_2$ is indicated electromotively, but the presence of Na_4Sn_3 could not be detected. $NaSn_2$ is at least 980, NaSn at least 1080, millivolts less noble than tin. Na_2Sn and Na_4Sn are 520 and 240 millivolts nobler than sodium. H. W.

The Theory of Electrolytic Ions. XIX. Determination of the Size of the Benzene Nucleus from [Electrical] Conductivity. RICHARD LORENZ (*Zeitsch. anorg. Chem.*, 1920, **113**, 131—134. Compare A., 1920, i, 897).—The radius of an ion and its mobility at 25° are connected by the expression $\rho = 1/v_{25} \times 89{\cdot}54 \times 10^{-8}$; making use of this expression, the authors have calculated the ionic radii of the various anions of the substituted arsinic acids from data previously published (A., 1919, i, 777, 897). It is found that the univalent ions have about the same radius, $3{\cdot}83 \times 10^{-8}$ cm., the bivalent $4{\cdot}40 \times 10^{-8}$, the tervalent $4{\cdot}68 \times 10^{-8}$ cm., whilst the *p*-phenylenediarsinic ion has a radius $7{\cdot}0 \times 10^{-8}$ cm. From these figures, it is concluded that the value $6{\cdot}2 \times 10^{-8}$ cm. found by Debye is too large for the radius of the benzene nucleus, whilst $1{\cdot}45 \times 10^{-8}$ found by Fajans (A., 1920, ii, 355) is too small. J. F. S.

Theory of Electrolytic Ions. XX. Hertz's Theory of Ionic Mobility. RICHARD LORENZ (*Zeitsch. anorg. Chem.*, 1920, **113**, 135—140. See preceding abstract).—A theoretical paper in which the constants A and A' of Hertz's theory of ionic conductivity (A., 1912, ii, 120) are numerically evaluated and brought into a suitable form for general use. These have the form $A' = 167{\cdot}7/T^3 \times 10^9$, and since $A = \sqrt[3]{A'}$, $A = 5515/T$. An expression has been evolved for multivalent ions, and this has the form $A' = v^6 . 167{\cdot}7/T^3 \times 10^9$ and $A = v^2 5515/T$, where v is the valency. The relationship between the ionic mobility and the conductivity is discussed, and it is shown that only when the conductivity is regarded as a function of the concentration can a Hertz curve be constructed if the A constant is regarded as a universal constant, as is demanded by the theory. J. F. S.

The Theory of Electrolytic Ions. XXI. A First Proof of Hertz's Theory of Conductivity. RICHARD LORENZ and PHILIPP OSSWALD (*Zeitsch. anorg. Chem.*, 1920, **114**, 209—233).—The conductivities of aqueous solutions of sodium acetate were determined with an accuracy of 0·1%. From the numerous

points on the curve of conductivity plotted against concentration, it was possible to test the empirical laws of extrapolation to infinite dilution and the law of Hertz (A., 1912, ii, 120). The two empirical equations of Kohlrausch were found to break down, but the results agreed extremely well with Hertz's theory. The values at infinite dilution for sodium acetate were calculated as: 10°, $\mu_0=63\cdot15$; 18°, $\mu_0=76\cdot56$; 25°, $\mu_0=90\cdot05$. The absolute value of the universal constant in Hertz's formula was not confirmed, although its change with temperature agreed approximately with the theory. The constant is not universal, but must be found for each electrolyte. J. R. P.

Accurate Measurement of the Electrical Conductivity of Electrolytes at Temperatures up to 1600°. F. M. JAEGER and B. KAPMA (*Zeitsch. anorg. Chem.*, 1920, **113**, 27—58).—The authors have described a method for the determination of the electrical conductivity of molten salts which may be used up to 1600°. An electric tube furnace is employed for obtaining the required temperature, which may be kept constant to 0·1°. Temperature measurements are made by means of a platinum–platinum-rhodium thermo-element, which is placed exactly in the centre of the melted salt. The electrode vessel is a small platinum tube with a rounded bottom (35 mm. diam. and 10 mm. high), which is suspended in the tube furnace by three platinum wires 1·5 mm. diam. The crucible itself constitutes one electrode, and the other is a similar vessel of 10 mm. diameter. The platinum used must be absolutely free from iridium. Full details are given for the determination of the cell constant, and all precautions necessary in the measurements are fully described. The following salts have been measured over the temperature range indicated, and the molecular conductivity is given in tables, which are reduced to a general formula in each case, by means of which the molecular conductivity may be calculated for any temperature. Potassium nitrate (346·1—500·4°), $\mu_t=36\cdot21+0\cdot1875(t-350)$; sodium nitrate (321·5—487·3°), $\mu_t=41\cdot56+0\cdot205(t-300)$; lithium nitrate (272·0—440·6°), $\mu_t=41\cdot14-0\cdot238(t-300)$; rubidium nitrate (318·8—493°), $\mu_t=33\cdot51+0\cdot145(t-300)$; cæsium nitrate (446·6—556·3°), $\mu_t=42\cdot13+0\cdot120(t-450)$; potassium fluoride (863·0—975°), $\mu_t=101\cdot8+0\cdot3163(t-900)$; potassium chloride (775·7—943·5°), $\mu_t=115\cdot4+0\cdot2575(t-800)$; potassium bromide (745·2—868·6°), $\mu_t=90\cdot09+0\cdot1906(t-750)$; potassium iodide (691·5—814°), $\mu_t=85\cdot41+0\cdot1564(t-700)$; sodium molybdate (843—1408°), $\mu_t = 107\cdot50+0\cdot183(t-850)$; sodium tungstate (752·5—1501°), $\mu_t = 83\cdot50+0\cdot185(t-750)$. The experimental values are compared with those calculated by the formulæ, and in every case there is a good agreement. J. F. S.

The Determination of Conductivity of Electrolytes by means of an Alternating Current Galvanometer. A. H. W. ATEN (*Chem. Weekblad*, 1921, **18**, 51—52).—An investigation of

the suitability of the alternating-current galvanometer of Leeds and Northrup for the determination of conductivity by the Kohlrausch method. With sufficiently high resistances, and with platinised electrodes of sufficient surface, an accuracy of 0·3% can readily be obtained. The apparatus is suitable for various technical purposes, and can be arranged to give continuous automatic records. S. I. L.

Connexion between the Limiting [Electrical] Conductivity λ_∞ of Binary Electrolytes in Non-aqueous Solvents and the Viscosity η_∞ of the Latter: $\lambda_\infty . \eta_\infty$ = Constant. P. WALDEN (*Zeitsch. anorg. Chem.*, 1920, **113**, 85—97).—From a consideration of a large amount of data previously published by the author and others, and a small amount of new data, it is shown that the product $\lambda_\infty . \eta_\infty$ = constant for a large number of acids and some salts in non-aqueous solvents. This rule holds for mixtures of solvents as well as for individual solvents. Water also obeys this rule when mixtures of solvents poor in water are considered, and when aqueous solutions of electrolytes with highly complex ions are considered. The temperature-coefficients of the viscosity and the limiting conductivity are practically identical, that is, $1/\lambda_\infty . d\lambda_\infty/dt = -1/\eta_\infty . d\eta_\infty/dt$, or the empirical rule $\lambda_\infty . \eta_\infty$ = constant is independent of the temperature and the nature of the solvent over the temperature range 0—50°. The absolute value of $\lambda_\infty . \eta_\infty = k$ depends on the nature of the electrolyte, and in the case of binary electrolytes varies between 0·5 and 1·0. Variations from the rule are found in solvents which have a high viscosity or which show a high molecular association; in these cases, the molecules of the solvent are relatively large, and will change their size with changes of temperature or concentration, and thereby change the degree of solvation of the electrolytes. To such solvents are to be numbered glycerol, ethylene glycol, formamide, and mixtures of these with water, sulphur dioxide, and ammonia. J. F. S.

Ionisation of Strong Electrolytes. WILLIAM D. HARKINS (*Proc. Nat. Acad. Sci.*, 1920, **6**, 601—605).—A discussion of the significance to be attached to the terms ion, ionisation, and dissociation. The author suggests that, to avoid confusion of ideas, the word ion should only be used for the charged particles which are free to move under a potential difference, and that for particles, which are not free to move, to which the term ion has also been applied by Sutherland, Milner, and Ghosh, the term polar atom should be used. Ghosh and others maintain that all strong electrolytes are completely ionised in solution, and for this condition the author suggests that the term ionisation be reserved, although it is not implied that the whole of the charged particles are free to move. For the other conceptions, the terms electrolytically dissociated and thermodynamically dissociated should be applied. J. F. S.

Dissociation of Ternary Electrolytes. C. DRUCKER (*Zeitsch. physikal. Chem.*, 1920, **96**, 381—427. Compare A., 1905, ii, 371; 1911, ii, 687; 1913, ii, 1015).—The dissociation relationships of sulphuric acid, oxalic acid, and tartaric acid, and the normal and hydrogen salts of these acids with thallium and potassium, have been investigated. The ionic concentrations were obtained either by *E.M.F.* measurements, cryoscopic measurements, or by conductivity measurements. It is shown that dilute solutions of concentration below 0·04*N* follow the law of mass action, and this occurs in certain cases also at higher concentrations. In some cases, a qualitative proof of the presence of complex ions is obtained. It is shown that the ionic conductivity of the primary ion of dibasic acids may be calculated by means of the formula of the type

$$\mu c = a\lambda_{Tl} + s\lambda_{SO_4} + s_a\lambda_{TlSO_4},$$

where μ is the molecular conductivity, c the concentration, λ_{Tl}, λ_{SO_4} and λ_{TlSO_4} the mobilities of the ions named, a the concentration of Tl', s that of SO_4'', and s_a that of $TlSO_4'$. Using this type of formula, the conductivity values of salts of the type Na_2SO_4 may be employed in the investigation of the dissociation of such salts, and in such cases it is found that in both dissociations the dilution law is followed. In all such cases, it therefore follows that the introduction of correcting factors into the dilution law are unnecessary. J. F. S.

Theoretical Considerations Concerning the Diamagnetism of Monatomic Gases. W. PAULI, jun. (*Zeitsch. Physik*, 1920, **2**, 201—205).—Debye has shown (A., 1920, ii, 356) that the cohesive force of a gas, an expression due to van der Waals, can be determined from the dielectric constant of the gas and certain principal electric moments of the molecules or atoms of the gas. The value of the cohesive force can, moreover, be calculated either from the value of a in van der Waals's equation for the gas, or from the temperature-coefficient of viscosity of the gas. Following the method of Langevin, the author shows that the magnetic moment of the atom of a monatomic gas can be expressed in terms of the moments referred to, and deduces the relation $\chi_A = 5{\cdot}96 \times 10^{19}\theta$, for the atomic diamagnetism χ_A of a monatomic gas, where $\theta = \frac{3}{2}\Sigma er^2$, r being the distance of the electron from the axis of the external field passing through the atomic nucleus. Corrected experimental values for the atomic magnetic susceptibilities χ_A of helium and argon give $\chi_A = 4{\cdot}6 \times 10^{-5}$ for helium, and χ_A for argon $= 25{\cdot}2 \times 10^{-5}$ or $23{\cdot}3 \times 10^{-5}$. These values lead to a value of θ for helium equal to $7{\cdot}7 \times 10^{-25}$ and for argon equal to 42×10^{-25} or 39×10^{-25}. Assuming atomic dimensions to be of the order 10^{-8}, these values are much larger than those to be anticipated from the kinetic theory. The observed susceptibilities of helium and argon are at least ten times larger than those anticipated from theoretical considerations.

J. S. G. T.

Action of Light on the Thermal Conductivity of Selenium. BIANCA NANNEI (*Nuovo Cim.*, 1920, [iv], **20**, ii, 185—200).—The results of the author's measurements show that the thermal conductivity of crystallised selenium is increased by the action of light, but to an extent apparently less than is shown with the electrical conductivity. This effect seems to diminish as the temperature rises. T. H. P.

The Problems of Temperature Radiation of Gases MEGH NAD SAHA (*Phil. Mag.*, 1921, [vi], **41**, 267—278).—The results of King (*Astrophys. J.*, vols. 28, 34, 35, 37) indicate that temperatures between 2000° and 3000° are necessary for the excitation of the characteristic line radiation of the alkalis, alkaline earths, thallium, iron, vanadium, etc. In general, it appears that the higher the ionisation potential of an element the greater the difficulty of exciting its line spectrum. On the basis of the theory of electronic orbits, and the quantum theory of radiation, as developed by Bohr, Planck, Sommerfeld, Paschen, and Rubinowicz, the electronic orbits are classified according to their respective rotational and radial quantum numbers. The intensity of a spectrum line depends on the products of the relative proportions of orbits in the initial and final states of the appropriate electrons and on the chance of changing from one orbit to another. An investigation of the statistical distribution of atoms into different possible stable orbits, when the gas is subjected to a thermal stimulus, shows that a very small concentration of radiant atoms suffices for the emission of the lines of the principal series of the element. Employing Paschen's notation, the lines $(2, p)-(m, d_1)$, $(2, s)-(m, p)$, $(3, d)-(m, f)$ require gradually increasing concentrations of radiant matter. The following are respectively the temperatures of complete ionisation, temperature at which luminescence appears, and the temperature of maximum luminescence in the case of the respective elements: H, 24000°, 5000°, 12000°; He, 32000°, 11000°, 17000°; Mg, 24000°, 7500°, 11000°; Ca, Sr, Ba, 8000—10000°, 1500°, 4000°. The theory is applied to the phenomena of the reversal of spectral lines by absorption, and affords an explanation of the phenomenon observed by Wood and others, that in the case of sodium vapour, only the lines of the principal series are reversed. Reversal of the lines $(2, p)-(m, d)$ would occur at higher temperatures, and the lines of the Bergmann series, $(3, d)-(4, b)$, would be reversed at still higher temperatures. Such reversal of the Bergmann series should take place in the case of the alkali metals at 2000—3000°. J. S. G. T.

Thermodynamics of Mixtures. IV. MARIO BASTO WAGNER (*Zeitsch. physikal. Chem.*, 1920, **96**, 287—311. Compare A., 1920, ii, 596, 597).—A mathematical paper in which, among other things, it is shown that the assumption of Nernst ("Grundlagen des neuen Wärmesatzes," 1918, p. 157) that the drop in the specific heat of a given mass of a gas occurs earlier the greater the density, is a

natural consequence of his first assumption that every gas which is cooled at constant volume without condensation eventually reaches a condition of vanishingly small heat capacity. J. F. S.

Chemical Constants and Critical Data. FR. A. HENGLEIN (*Zeitsch. anorg. Chem.*, 1920, **114**, 234—240).—The chemical constant is calculated by the equation $C=\lambda_0/4\cdot571T$, where $\lambda=(\lambda_0+AT-BT^2-\ldots)(1-p/p_k)$ is the latent heat and p_k, T_k the critical constants. Nernst's equation, $C=0\cdot14\lambda/T_B$, where T_B is the absolute boiling point, follows from van der Waals's equation, $\log p/p_k=a(1-T_k/T)$. Cederberg's equation, $C=k\log p_k$ (where k is 1·6 in many cases) also follows from this equation, since it is a special case of the more general equation, $C=1\cdot1\log p_k/(T_k/T_B-1)$. The formula $\log p(\text{atm.})=-2642/T+2\cdot5\log T-0\cdot012175T+8\cdot474\times10^{-6}T^2-1\cdot3325\times10^{-9}T^3+4\cdot08355$ holds for water from 0° to the critical point; for oxygen the equation $\log p(\text{atm.})=-438\cdot8/T+2\cdot5\log T-0\cdot33752T+1\cdot223\times10^{-6}T^2-4\cdot0085\times10^{-7}T^3+2\cdot84387$ is deduced. J. R. P.

Critical Data and Valency in Organic Compounds. W. HERZ (*Zeitsch. anorg. Chem.*, 1920, **114**, 153—156).—It has been shown in previous papers (A., 1920, ii, 285, 414) that, if T_k, p_k, v_k represent critical temperature, pressure, and volume respectively, and z the sum of the valencies of the atoms contained in the molecule, $T_k/p_k\,.\,z=0\cdot44$ and $v_k/z=0\cdot00044$. From this it follows that $v_k\,.\,p_k/T_k=1\,.\,10^{-3}$, a relation which is now shown to hold with a fair degree of approximation for a number of organic compounds, principally aliphatic esters. It was shown in the papers referred to that, in the aromatic compounds, the value of the quotient $T_k/p_k\,.\,z$ tended to be low, about 0·37, instead of 0·44, the mean value, whilst in many aliphatic compounds it was nearer 0·49. It is now shown that if the ring carbon atoms in aromatic hydrocarbons are assumed to be tervalent instead of quadrivalent, the value of the above quotient for these hydrocarbons is increased to about 0·49, corresponding closely with the value for aliphatic compounds. This may have some significance in view of the supposed relationship between the structure of aromatic compounds and the crystal structure of graphite as determined by means of X-rays. E. H. R.

Theorem of Corresponding State and the Quantum Theory of Gases and Liquids. A. BYK (*Physikal. Zeitsch.*, 1921, **22**, 15—20).—A theoretical paper, in which the quantum theorem is applied mathematically to the theorem of corresponding state, and an expression is evolved which represents the whole of the physical thermodynamics of the liquid state. J. F. S.

Approximate Calculation of the Latent Heat of Fusion of the Liquefied Inactive Gases. J. NARBUTT (*Physikal. Zeitsch.*, 1921, **22**, 52—53).—The expression $A\rho/\theta=$constant for the elements of any given sub-group has been used to calculate the

latent heat of fusion of the inactive gases. The constant in the present case has been calculated from the experimental determination of the latent heat of fusion of argon (Eucken, *Beibl. Ann. Phys.*, 1916, **40**, 322), which has the value 0·268, $A\rho$ is the latent heat of fusion in Cals., and θ the melting point in degrees absolute. In this group the constant therefore has the value 0·0032. The following values in Calories have been obtained for the latent heat of fusion: helium, $<$0·004; neon, 0·08; argon, 0·268; krypton, 0·33; xenon, 0·43; and niton, 0·65. J. F. S.

Influence of Surface Tension on Fusion and Solidification. ERNST RIE (*Wien. Anz.*, 1920, 137—139; from *Chem Zentr.*, 1920, iii, 868).—In connexion with a communication by Pavlov (A., 1909, ii, 19) the author develops an expression for the dependence of the melting point, T_2, of small, crystalline granules on the surface tension, S_{23} (free energy of the surface), in the form $T_p - T_0 = -T_0 \times 2S_{23}/s_3rq$, where T_0 is the limiting melting point (without reference to surface energy), s_3 the density of the solid phase, r the radius of the crystalline granules considered as spheres, and q the latent heat of fusion. This expression, which is derived from the Gibb's equilibrium conditions by purely thermodynamic reasoning, and is readily adapted to the case of a drop enclosed within a crystal, gives results differing from those of Pavlov. Further observations of the melting points of crystals are necessary to decide which of the conditions, $S_{13} \gtreqless S_{12} + S_{23}$, is valid. Probably, the majority of amorphous substances are composed of extremely minute crystals, the size of the granules being $<10^{-5}$ cm.; the absence of a definite melting point is to be ascribed to surface tensions. H. W.

A Simple Method for the Determination of Melting Points and Critical Temperatures. HERMANN RASSOW (*Zeitsch. anorg. Chem.*, 1920, **114**, 117—150).—An apparatus was devised for melting-point determinations consisting of a solid cylinder of copper 10 cm. long and 5 cm. in diameter bored with an axial hole to a short distance below the centre for taking the specimen, a parallel hole for a thermo-couple, and a transverse hole intersecting the first hole at the centre of the cylinder. Through the transverse hole the specimen, illuminated by a lamp placed opposite the other end, was viewed through a telescope. The cylinder was heated electrically by a winding of nickel wire. The substance to be examined was sealed up in a tube of hard glass or transparent quartz, which was suspended through the axial hole in the field of view of the telescope. With this apparatus temperatures up to 1080° could be obtained with a limit of error ±1°. The following melting points were determined· potassium iodide, 684·1°; potassium cyanide, 601·2°; ammonium chloride, 519·7°; ammonium bromide, 541·9°; ammonium iodide, 551±3°, the accuracy being interfered with by dissociation; tetramethylammonium chloride, 420°±10°, much dissociation occurring; arsenic, 818°. Experiments were also made

on the melting points of mixtures of ammonium chloride with haloids of alkali metals. The method is not suitable for the determination of complete melting-point diagrams of mixtures, but serves to indicate whether miscibility of two salts is possible or not. With a quartz manometer on the principle of the Bourdon spiral, a determination of the vapour pressure of ammonium chloride between 340° and 520° was made. At 520° the vapour pressure is 37·5 atmospheres.

The melting-point apparatus was also used for the determination of some critical temperatures. The results obtained were: mercuric chloride, 704°; mercuric bromide, 738°; mercuric iodide, 797°; sulphur, 1040°; iodine, 553°. The critical temperatures of arsenic and mercury are above 1400°. E. H. R.

Vapour Pressure. LÉON SCHAMES (*Zeitsch. Physik*, 1920, **1**, 198—203).—A theoretical paper, in which certain problems in connexion with vapour pressure are mathematically discussed, particularly those relating to the latent heats and the chemical constants. J. F. S.

The Vapour Pressure and Sublimation Curves for some Important Metals. J. A. M. VAN LIEMPT (*Zeitsch. anorg. Chem.*, 1920, **114**, 105—116).—The formulæ deduced in a previous paper (A., 1920, ii, 588) are made use of in discussing the vapour pressures and sublimation pressures of the metals tungsten, platinum, molybdenum, copper, tin, lead, zinc, silver, bismuth, cadmium, antimony, and gold. E. H. R.

Distillation Apparatus for Small Quantities of Liquid. CARL WOYTACEK (*Chem. Zeit.*, 1921, **45**, 82).—The apparatus consists of a conical flask of 100 c.c. capacity and a small double-surface condenser attached vertically to the flask by a ground-in joint; the exit tube for the condensed vapours is near the lower end of the condenser. W. P. S.

Breaking of Halogen Bonds. A. VON WEINBERG (*Zeitsch. Physik*, 1920, **3**, 337—342).—By means of the expression $Q_{[M-Hal]} = a+b+c-d+Q_{[M]}+Q_{H-Hal}-\frac{1}{2}Q_{H}$, in which a is the heat of reaction of the solid metal [M] with water, b the heat of solution of the hydrogen haloid, c the heat of neutralisation, d the heat of solution of the salt, and Q the work of dissociation into atoms, the heat of dissociation of many halogen salts has been calculated. The following values of $Q_{[M-Hal]}$ have been obtained: LiCl, 193·2; NaCl, 181·4; KCl, 183·9; RbCl, 183·8; CsCl, 184·2; LiBr, 150·1; NaBr, 140·1; KBr, 144·2; RbBr, 145·0; CsBr, 145·8; LiI, 129·0; NaI, 120·9; KI, 126·6; RbI, 127·9; and CsI, 129·8. If the heat of sublimation is known, the work of dissociation of the compounds in the gaseous condition may be calculated. The heat of sublimation has been calculated, and the following values obtained: NaCl, 48·8; NaBr, 45·7; NaI, 43·3; KCl, 48·2; KBr, 45·2; KI, 44·9; and the

energy of dissociation of the vapours found to be: NaCl, 132·6; NaBr, 94·4; NaI, 77·6; KCl, 135·7; KBr, 99·0; and KI, 81·7.

J. F. S.

Volume and Heat of Hydration of the Ions. M. BORN (*Zeitsch. Physik*, 1920, **1**, 45—48. Compare A., 1919, ii, 204; Fajans, A., 1920, ii, 154).—In a previous paper Fajans (*loc. cit.*) has calculated the heat of hydration of certain ions on the basis of the author's formula for the lattice energy of binary salts (*loc. cit.*). The author now shows that the values put forward by Fajans are too large by about 100 Cals. in the case of the kations and too small in the case of the anions by about the same amount. A simple method of deducing the heat of hydration, W, is given, and the formula $W=\frac{1}{2}(1-1/\epsilon)N\,.\,2388\times10^{-11}e^2z^2/r_i$ Cals. deduced, in which N is the Avogadro number, z the valency, e the charge, and r_i the radius of the ion, and ϵ the dielectric constant of the solvent. Inserting the values for water as solvent, $W=1{\cdot}64\times10^{-6}z^2/r_i$ Cal. Using this equation, the following values of W are calculated: H˙, 262; Li˙, 110; Na˙, 103; K˙, 82, Rb˙, 78; Cs˙, 74; Tl˙, 82; and Ca˙˙, 344; Cl′, 77; Br′, 68; and I′, 57. The values of r_i and r_a, the atomic radius, are also calculated, and it is shown that for positive ions $r_i<r_a$ and for negative ions $r_i>r_a$. The only exception to the above regularities among the elements examined is found in the case of thallium, where $r_i=2{\cdot}00\times10^{-8}$ and $r_a=1{\cdot}89\times10^{-8}$. If the above regularities are not due to chance, they indicate that the formation of a positive ion involves the removal of the outside electron of the atom, and in consequence the ion volume must be smaller than the atomic volume. The formation of a negative ion involves the absorption of an electron into the atomic structure, and consequently the ion has a larger volume than the atom.

J. F. S.

Heat of Mixture. H. CASSEL (*Zeitsch. Physik.*, 1920, **2**, 146—147).—The author advances a theoretical proof of the general validity of Dolezalek's principle discussed in a previous paper (A., 1920, ii, 664), namely, that every heat tone accompanying the mixture of condensed matter or every change of curvature in the vapour density isothermal is characteristic of a chemical reaction.

J. S. G. T.

Calculation of the Heat of Sublimation of the Alkali Haloids from the Lattice Structure. A. REIS (*Zeitsch. Physik*, 1920, **1**, 294—298).—On the basis of Born's method of calculating the ionisation energy from the atom ion lattice (A., 1919, ii, 204), the author has calculated the heat of sublimation of the alkali haloids. The following values are given: lithium chloride, bromide, and iodide, 15—35; sodium chloride, 58; sodium bromide, 55; sodium iodide, 51; potassium chloride, 52; potassium bromide, 50; potassium iodide, 46; rubidium chloride, 50; and cæsium chloride, 50. The present values are compared with those calcu-

lated by Haber (*Verh. Deut. Phys. Ges.*, 1919, **21**, 750), and a fairly good agreement found. J. F. S.

Dependence of the Heat of Vaporisation of Water on the Temperature. H. von Steinwehr (*Zeitsch. Physik*, 1920, **1**, 333—336).—A theoretical paper in which the author deduces an expression showing the dependence of the heat of vaporisation on the temperature, and the difference between the specific heats of the liquid and vapour. This expression has the form

$$r=[(dr/dT)_0-r_0/T_0]\{(1-aT_0)T\log_e T+aT^2\}+KT,$$

in which r is the heat of vaporisation per gram, T the absolute temperature of the process, and K a constant. The quantity, $dr/dT-r/T=h-s$, where h is the specific heat of the saturated vapour and s that of the liquid. Evaluating the constants and inserting them in the equation gives $r=-2{\cdot}098(1{\cdot}66776T\log_e T-1{\cdot}7874\times10^{-3}T^2)+20{\cdot}765$. The equation is tested by plotting the values of $dr/dT-r/T$ against T, when a straight-line curve is obtained, and the calculated values of r from 30·12° to 180·72° are compared with the experimental values of Henning (*Ann. Physique*, 1909, [iv], **29**, 441) for water, when a remarkably good agreement is found. J. F. S.

The Heat of Vaporisation of Water as a Function of the Temperature. F. Henning (*Zeitsch. Physik*, 1920, **2**, 197—199). —A simple thermodynamic proof is advanced of the result obtained by Steinwehr (preceding abstract) for the difference in the respective specific heats at constant pressure of water in the vapour and liquid states, the vapour pressure being small. Making certain assumptions, the relation deduced from a well-known thermodynamic relation takes the form $dr/dt=(c_p)_1-(c_p)_2$, where r is the latent heat of vaporisation at temperature $t°$, and $(c_p)_1$, $(c_p)_2$ the respective specific heats in the vapour and liquid states. The values of dr/dt deduced from experimental values of $(c_p)_1$ and $(c_p)_2$ are in close agreement with the experimental values of dr/dt, corresponding with 40° and 50°, found by the author. Values are tabulated in the original for the latent heat of vaporisation of water, r, at temperature $t°$, and for the temperature-coefficient thereof. J. S. G. T.

Molecular Attraction. V. K. K. Järvinen (*Zeitsch. physikal. Chem.*, 1920, **96**, 367—374. Compare A., 1920, ii, 165).—In a previous paper (*loc. cit.*), the author put forward the formula m^2k/r^n as an attraction law. This was applied to mercury with values of $r=5$ or 6, by means of which the value of the heat of vaporisation of mercury at 360° was calculated to 15,350 and 12,300 respectively. These values are not in keeping with the thermodynamic value, which lies between 13,810 and 14,490. Consequently, the author has now tested the formula $F=m^2k/r^{5\cdot5}$ in the case of mercury, and finds that the value $n=5{\cdot}5$ is in better accord with fact. The latent heat of fusion has been calculated from the change in volume by means of the formula

$W_s = ks_1^{1\cdot5} - ks_2^{1\cdot5}$, where s_1 and s_2 are the densities of the solid and liquid respectively. A moderate agreement is found between the calculated and experimental values in the case of sodium and potassium, but in other cases the two values are widely divergent.

J. F. S.

The Relative Volumes of the Chemical Elements. HAWKSWORTH COLLINS (*Chem. News*, 1921, **122**, 62—66).—The relative volume of CH_2 at 15° is 16·42. The relative volumes at 15° of the following elements or radicles are: Cl, 23·01; Br, 27; I, 32·75; NH_2, 16·42; CN, 23·96; N_3, 32·63; NO_2, 26·74; NO_3, 34·27; SH, 25·48; C_2H_3, 41·87; C_2H_2, 28·89; C_2H, 31·25; CO_2Me, 49·71; CO_2Et, 66·13; CO_2Pr, 82·55; $CO_2{\cdot}C_4H_9$, 98·97; $CO_2{\cdot}C_5H_{11}$, 115·39; C_6H_5, 77·48; C_6H_5, 74·45; OH, 13·29; OH, 10·21; CCl_3, 69·74; CO·OH, 23·8.

J. R. P.

The Molecular Volumes of the Alkali Haloids. K. FAJANS and H. GRIMM (*Zeitsch. Physik*, 1920, **2**, 299—308).—The values of the respective densities, molecular weights, molecular volumes, and coefficients of cubical expansion of the haloid salts of lithium, sodium, potassium, rubidium, and cæsium, as determined by various observers, are tabulated. It is shown that a linear relation of the form $y = ax + a$ holds between the molecular volume, y, of one haloid salt and the corresponding value, x, of another haloid, the two salts containing a common kation or anion. This relation is exemplified by the relations $V_{Kx} = 1{\cdot}130V_{Nax} + 6{\cdot}95$, $V_{MBr} = 1{\cdot}070V_{MCl} + 3{\cdot}16$, $V_{Nax} = 1{\cdot}112V_{Lix} + 4{\cdot}25$. The values of a and a are tabulated in the case of all the haloid salts of the alkali metals, employing Baxter's values of the densities of lithium, sodium, potassium, and rubidium haloids. In the case of the fluorides of cæsium and rubidium, the respective molecular volumes are deduced from those of the fluorides of lithium, sodium, and potassium, assuming the above linear relation to hold. The respective molecular volumes so deduced are 29·1 cm.^{3} for cæsium fluoride and 28·8 cm.^{3} for rubidium fluoride at 25°. Whilst the atomic volume of cæsium, 71·0, is much larger than that of rubidium, 55·8, the molecular volumes of the iodide, bromide, and chloride of cæsium are smaller than the corresponding molecular volumes of the rubidium haloids. The question is raised as to whether the crystalline structure of the cæsium haloids is the same as that of the other alkali haloids. The difference between the molecular volumes of any two haloids containing either a common kation or anion increases with increase in the molecular volume of the common constituent. In the linear relation specified, the values of a and a increase together, except in the case of the cæsium salts. On the basis of the hypothesis of Born, namely, that the outside electrons in the atoms are arranged along the edges of a cube, the distance between neighbouring, oppositely charged ions in the haloid salts is shown to be given by the relation $r = 0{\cdot}938 \times 10^{-8}\sqrt[3]{V}$ cm., where V is the molecular volume of the salt. The values of r are tabulated. It is pointed out

that the difference between the respective spheres of influence of two ions combined with a common ion decreases with increase in the molecular dimensions of the common constituent. The sphere of influence of an ion is not a sharply defined magnitude, but depends on the ions in the neighbourhood of the ion in question. The sphere of influence of an ion is not an additive quantity, even at absolute zero. J. S. G. T.

The Effect of Adsorbed Gases on the Surface Tension of Water. SHANTI SWARUPA BHATNAGAR (*J. Physical Chem.*, 1920, **24**, 716—735).—The disk method of measurement was used with a segment of a quartz sphere as the disk, a spring being used as a Joly's balance. The values for the surface tension of water in various gases at 15°, expressed as dynes, were: in a vacuum 71·3, in hydrogen 72·83, in nitrogen 73·00, in carbon monoxide 73·00, in carbon dioxide 72·85, in air 73·1. Excepting for carbon dioxide, the increase in value of T for water in gases is proportional to the rise in their densities. Stöckle and Meyer's data for the values of T for mercury show a similar discrepancy with carbon dioxide (compare Freundlich, "Kapillarchemie," 1909, 86). W. G.

The Use of Silica Gel as an Adsorbent for Vapours. E. B. MILLER (*Chem. and Met. Eng.*, 1920, **23**, 1155—1158, 1219—1222, 1251—1254).—Special characteristics of the silica gel which render it adaptable to the adsorption of vapours are its easy preparation by coagulation of a colloidal solution of silicic acid, uniform reproduction, and its inertness and stability at even high temperatures. Its use was therefore tested in investigations on adsorption phenomena. The fact that vapours of liquids of high boiling point are more readily adsorbed, and that adsorption decreases with increasing temperature but increases with the partial pressure of the vapour, suggest that condensation of the vapour in the adsorbent takes place. Factors which influence adsorption are the ratio of the partial pressure of the vapour, P, to its vapour pressure at the temperature of adsorption, P_0, this ratio, P/P_0, being termed the "corresponding pressure," and the compressibility of the adsorbed liquid; to secure activity of the adsorbent, its internal volume must be as large as possible, and made up of spaces of minimum dimension. Increase of temperature reduces adsorption, whilst increase of concentration improves it. Recovery of adsorbed vapours is effected by raising the temperature of the gel, or by decreasing the partial pressure of the vapours, either by exhaustion or by displacement with air, steam, or other gas. Laboratory scale experiments were carried out with mixtures of air and sulphur dioxide, ether, acetone, benzene, light petroleum, and water vapour; the saturation values and efficiency of adsorption from given concentrations are tabulated and plotted on curves, and the yields of recovered vapour are given in each case. [See *J. Soc. Chem. Ind.*, 1921, Mar.]

W. J. W.

Calculation of the Diffusion Constant of Dissolved Substances. HANS VON EULER and ARVID HEDELIUS (*Zeitsch. anorg. Chem.*, 1920, **113**, 59—68).—Experiments have been made to ascertain to what extent the presence of other substances influences the velocity of diffusion of a given substance, and a method is devised whereby the diffusion constant may be calculated in the case of moderately concentrated solutions. The method is expressed by the following rule. The diffusion constant of a solution of a given concentration obtained experimentally is multiplied by the coefficient of viscosity of a solution of one-fourth the concentration of the original solution and divided by the relative osmotic pressure of the dilute solution. Curves are given for the variation of the relative viscosity with concentration, and the relative osmotic pressure with concentration for solutions of sucrose of concentrations 0—1*N*.

J. F. S.

Hydro-diffusion of Magnesium Ammonium Sulphate and Separation of its Component Salts. C. PORLEZZA (*Gazzetta*, 1920, **50**, ii, 285—296).—The diffusion of magnesium ammonium sulphate solution has been investigated by means of the method and type of apparatus described by holm (A., 1905, ii, 147). The ammonium salt is found to diffuse more rapidly than the magnesium sulphate (compare Rüdorff, A., 1889, 98; Torrance and Knight, A., 1918, ii, 299). The numerical results obtained in experiments at 10° confirm the observation that the coefficients of diffusion of two salts diffusing together undergo diminution, the velocity of diffusion diminishing the more for the salt having the less coefficient of diffusion Simple diffusion into water cannot effect complete separation of the two salts except by repeated diffusion of the diffusate. Better results should be obtainable by taking advantage of the fact that magnesium ammonium sulphate is only slightly soluble in presence of one of its components, so that concentration of a solution containing double salt and one component should lead to almost complete separation of the former. T. H. P.

Ionic Velocities in Non-aqueous Solutions. P. WALDEN (*Zeitsch. anorg. Chem.*, 1920, **113**, 113—124).—A theoretical paper, in which from previously published data the author shows that the product of the ionic conductivity and the viscosity of the solvent is a constant quantity, $l_a \times \eta_\infty$ = const., and $l_c \times \eta_\infty$ = const. The velocities of the ions are inversely proportional to the viscosity of the solvent, and these products are independent of the temperature. It is also shown that the transport number at infinite dilution is practically the same as that at any other dilution for dilute solutions. For one and the same ion in different solvents the same transport number is obtained. Aqueous solutions of various ions with the exception of the hydrogen ion give the same transport numbers as non-aqueous solutions, and in general it may be said that in high dilutions with highly dissociated binary electrolytes the transport numbers of a given ion are independent of the nature

of the solvent and of the temperature. This is expressed by the equation $l_a \cdot \eta_\infty / (l_a \cdot \eta_\infty + l_c \eta_\infty) = n_a = \text{const.} k_1$. J. F. S.

Diameter of Ions in Non-aqueous Solutions. P. WALDEN (*Zeitsch. anorg. Chem.*, 1920, **113**, 125—130).—A theoretical paper, in which, by means of Einstein's formula, $U = K/N \cdot 6\pi\eta\rho$, in which U is the velocity of a particle, K the force acting on a particle, N the Avogadro number, η the coefficient of viscosity, and ρ the radius of the particle, the radius of a number of ions in methyl alcohol solution has been calculated. It is shown that for most ions the value of ρ lies between $2{\cdot}0 \times 10^{-8}$ cm. and $3{\cdot}9 \times 10^{-8}$ cm. Hydrogen has a smaller value, $1{\cdot}1 \times 10^{-8}$, and lithium a larger value, $4{\cdot}70 \times 10^{-8}$ cm. The ionic radius in non-aqueous solvents follows the same order as in aqueous solutions, namely, $H^{\cdot} < K^{\cdot} < Ag^{\cdot} < Na^{\cdot} < Li^{\cdot}$ and $Br' < I' < Cl' < NO_3'$. In the case of the above-named simple ions the ionic radius in aqueous solutions and the atomic radius are practically the same except in the extreme cases hydrogen and lithium, whilst in non-aqueous solutions the values of the ionic radius are about twice as great. The mean values obtained are, in aqueous solution $2{\cdot}67 \times 10^{-8}$ cm., and in non-aqueous solution $5{\cdot}33 \times 10^{-8}$ cm. A further set of ions, consisting of organic anions and kations, has the same ionic radius in both aqueous and non-aqueous solutions, the mean value in this case being $4{\cdot}4 \times 10^{-8}$ cm. The difference in the radius in the case of the simpler ions is held to indicate a much greater solvation in non-aqueous solvents than in water. J. F. S.

Aqueous Solutions. OTTO PULVERMACHER (*Zeitsch. anorg. Chem.*, 1920, **113**, 141—148).—It is shown that the formula $\eta_x = Ax + 1$ represents the viscosity of aqueous solutions equally as well as the formula of Arrhenius $\eta_x = A^x$ (A., 1898, 336). In the case of mixed solutions the author puts forward the formula $\eta_{xy} = \eta_x + \eta_y - 1$ in place of the Arrhenius formula $\eta_{xy} = A^x \cdot B^y$. Both formulæ give equally good results, and in all cases except the most concentrated solutions are in keeping with the observed results. The author has determined, at 25°, the relative viscosity, the absolute fluidity (ψ), the density, d_4^{25} the specific volume, v, and the refractive index, n_D, for solutions of sodium chloride, ammonium sulphate, and mixtures of the two, magnesium sulphate, potassium sulphate, magnesium chloride, potassium chloride, and binary mixtures of these. It is shown that the viscosity may be calculated for the mixtures by the above-mentioned formula with fair accuracy, but, using the fluidity and the usual mixture rule as suggested by Bingham (A., 1909, ii, 382), much better agreement between calculated and experimental values is obtained. Similar determinations have been made with dextrose, galactose, maltose, lactose, and sucrose, and it is shown in connexion with these substances the equation $K = \sqrt[3]{\eta}/n_D^2 \cdot d^2$ obtains, but for solutions of electrolytes the value of K is not in the least constant. J. F. S.

Significance of Recrystallisation. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1920, **113**, 163—178. Compare A., 1919, ii, 273).—The recrystallisation of metals when worked cold is discussed. It is known that when metals are worked cold or at temperatures much below the melting point large crystals are produced at the expense of the smaller crystals. The older distillation hypothesis put forward to explain the process is considered and shown to be incapable of successfully explaining it. The author puts forward a new hypothesis to explain the process, and considers a number of facts in connexion with recrystallisation from the point of view of this hypothesis, and in all cases finds it satisfactory. The hypothesis is as follows: Two contiguous crystals can only be in equilibrium with one another when the crystallographic equilibrium lattice planes of both crystals lie together in the same plane at the surface of contact, that is, when the space lattices of both crystals of the contiguous crystals form a single lattice or when the plane of contact is a twinning plane. If one or the other of these conditions is not fulfilled, then when the temperature is raised sufficiently to allow of a certain amount of change in the position of the atoms or molecules in the lattice, new lattices of mean orientation to the surface of contact will be formed, that is, a recrystallisation will commence. J. F. S.

Velocity of Migration of the Ions in Crystals. G. VON HEVESY (*Zeitsch. Physik*, 1920, **2**, 148—149).—Extraordinarily small values for the velocities of migration at the ordinary temperature of the ions in rock salt are deduced from the conductivity data of rock salt crystals by the application of the Einstein relation between diffusion and mobility. Thus in rock salt, the migration constant at 20° is about 3×10^{-18} cm.^{2} per day, about $1/10^{18}$ of that of the ions in the fused salt. The migration velocity increases rapidly with temperature, the migration "constant" in the case of rock salt attaining the value $1{\cdot}4 \times 10^{-5}$ cm.^{2} per day at 626°, about 1/3000 of that in the case of the fused salt. The migration velocities of the ions in crystals of lead chloride at a temperature 30° below the melting point of lead chloride have been determined by determining the rate of diffusion of radioactive lead chloride in a compressed mass of lead chloride crystals. The experimentally determined value of the migration constant at this temperature was 0·029 cm.^{2} per day, in satisfactory agreement with the value 0·027 cm.^{2} per day calculated as above. The calculated value at the ordinary temperature is 8×10^{-8} cm.^{2} per day. The agreement between experimental and calculated results in the case of lead chloride suggests that the calculated values in the case of rock salt are probably correct. In mixed crystals, migration velocities are, as a rule, greater than in crystals of a pure substance. In all cases, mixed and pure crystals alike, the migration velocity begins to increase rapidly at a temperature in the neighbourhood of the melting point, which is in agreement with the conclusion reached by Tammann from other considerations. While this preliminary

to the process of fusion commences at a higher temperature in the case of the nitrates than in the case of the chlorides of the alkalis, the converse is the case with the haloids of the heavy metals.

J. S. G. T.

The Crystal Lattice. A. REIS (*Zeitsch. Physik*, 1920, **2**, 57—59).—In this appendix to his previous paper (A., 1920, ii, 537) dealing with the classification of the several points of the crystal space-lattice into natural groups, the author advances evidence supporting his statement that the classification can be effected from geometrical considerations. The following rules hold for the various natural-point groups of the lattice. (1) A connecting line between two natural point groups can never be crystallographically equivalent to a connecting line in the interior of a group. (2) The shortest connecting line between two natural point groups is longer than the longest connecting line necessary for the internal cohesion of a natural point group. (3) The natural point groups are those satisfying conditions (1) and (2). No natural point groups exist in the case of most of the space-lattices of the metals hitherto determined. Such space-lattices are termed atomic-ion lattices. To this class belong the lattices of the diamond, silicon, the alkali haloids, fluorite, and zinc blende. A second class of space-lattice is characterised by two atomic point groups. These are termed radicle-ion lattices, and are exemplified by the cases of calcite and pyrites. It is surmised that the silicates characterised by their hardness, and salts of similar complex acids—the titanates, borates, phosphates, niobates, tungstates, etc.—possess space lattices belonging to a third class, the honeycomb lattices. Spinel is probably the simplest representative of this class.

J. S. G. T.

Phenomena in the Formation of Space Lattices Composed of Two Different Species of Atoms, particularly in the Formation of Mixed Crystals of Silver and Gold. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1920, **114**, 281—288).—When the soluble component of a mixed crystal is removed, the atoms of the insoluble residue may behave in four ways: (1) remain as an atomic dust or conglomerate of particles with irregular atomic grouping; (2) combine to microscopic crystals; (3) combine with the solvent or solute, although the substance in mass is not attacked; (4) combine together and attract other atoms to the chain.

With mixed crystals of gold and silver (and probably other metals), case (2) only occurs on extraction with sulphuric or nitric acids. With mixed crystals of platinum with silver or copper, cases (2) and (3) occur simultaneously. The behaviour of alloys of platinum with lead, bismuth, or zinc, containing platinum compounds, is similar. Mixed crystals of iron with silicon on treatment with hydrochloric acid give only silicic acid. Silicon hydride is evolved when the silicon is in combination with an electropositive metal, such as magnesium, which forms Mg_2Si. Iron–carbon mixed crystals give hydrocarbons with hydrochloric acid.

The residue of gold left after dissolving out the silver from an alloy was found by X-ray examination to be crystalline, although it was finely divided and almost black. At higher temperatures, the particles are larger and yellow. The separation of gold and silver is described. The residue of silver in the gold after treatment with acid is appreciable when the original alloy contains only small quantities of silver, and increases as the amount of silver in the alloy decreases. The amount is not appreciably altered by tempering. J. R. P.

Size of the Ions and Lattice Energy of the Alkali Haloids. K. FAJANS and K. F. HERZFELD (*Zeitsch. Physik*, 1920, **2**, 309—331).—On Born's theory of lattice energy, in which the potential energy of the residual neutral parts of the ions is inversely proportional to the ninth power of the distance, it is found that the lattice energy of the sodium haloids is 9 Cal. per mol. too large, assuming that the values for the potassium haloids are correct. Modifying Born's formula for the potential energy by the introduction of terms containing the inverse fifth power and the inverse seventh power of the distance, in the case of kations and anions of different sizes, an equation is derived whereby the ionic radii may be determined in numerous cases. Applying the results to the case of the alkali haloids, the following values are obtained for the ionic radii of the respective alkali cations and haloid anions: Na, $0{\cdot}517 \times 10^{-8}$ cm.; K, $0{\cdot}794 \times 10^{-8}$ cm.; Rb, $0{\cdot}914 \times 10^{-8}$ cm.; F, $0{\cdot}75 \times 10^{-8}$ cm.; Cl, $0{\cdot}953 \times 10^{-8}$ cm.; Br, $1{\cdot}021 \times 10^{-8}$ cm.; I, $1{\cdot}122 \times 10^{-8}$ cm. The values calculated therefrom for the distances between the atoms of the respective haloids are in very close agreement with observed values. The calculated values for these distances are, in 10^{-8} cm.: NaF, 2·34; NaCl, 2·817; NaBr, 2·980; NaI, 3·231; KF, 2·67; KCl, 3·141; KBr, 3·295; KI, 3·527; RbCl, 3·286; RbBr, 3·440; RbI, 3·672. The ionic dimensions are substituted in an expression involving the inverse first, fifth, and seventh powers of the distance, and corrected values of the respective lattice energies of the several alkali haloids are derived. The values so calculated in Cals. per mol., are: NaF, 210·4; NaCl, 170·0; NaBr, 159·7; NaI, 146·7; KF, 192·2; KCl, 159·0; KBr, 150·4; KI, 139·1; RbCl, 154·6; RbBr, 146·5; RbI, 135·8. These values are in closer agreement with values derived from experimental data than any hitherto deduced. The theory developed removes the discrepancy in the relative magnitudes of the lattice energies of the respective sodium and potassium haloids, and, moreover, explains the smaller relative value of the repulsion potential, derived from available compressibility data connected with the alkali haloids, in the case of the sodium salts as compared with the potassium salts. J. S. G. T.

The Molecular Directing Force in Liquid Crystals. O. LEHMANN (*Zeitsch. anorg. Chem.*, 1920, **113**, 253—305).—A theoretical discussion of the properties of different kinds of fluid crystals, as revealed by their optical behaviour. The properties

are best accounted for on the assumption that the fluid crystals have a leaflet-like structure, the units of which endeavour, as far as possible, to remain parallel, but can glide freely in a direction parallel to their faces (compare following abstract). E. H. R.

The Molecular Forces Operative in Liquid Crystals and their Relation to Known Forces. O. LEHMANN (*Zeitsch. Physik*, 1920, **2**, 127—145).—A critical review of the theory of Groth concerning the forces operative in the production of crystalline structure. The author contends that, in general, the surface of a crystal surrounded by another medium is a surface of uniform surface tension, and the orientation of the molecules of liquid crystals is in no way conditioned by surface tension considerations. Departure from the spherical form normally assumed by a surface of uniform surface tension is illustrated by imagining the molecules to be built up of a number of flat wedges the alternate edges of which are parallel, the whole being enclosed within a uniformly taut elastic membrane. The wedges move freely on rollers. A laminar structure is produced by the penetration of one set of wedges into the space between neighbouring wedges in an adjacent row. The production of a laminar structure as the result of anisotropy of the impacts of the molecules, due to temperature, is shown to be untenable. An explanation of the tendency of the molecules of a liquid crystal to possess directional properties is afforded by considering the molecules as analogous to astatic magnetic systems. The molecules may, in like manner, be regarded as constituted of positive atoms placed at the corners of a cube, about which electronic orbits are executed alternately in counter-directions. Crystalline structure originates in the tendency of the laminar molecules to be arranged at equal intervals, and their capability of gliding parallel to their flat surfaces. The term "liquid crystals" applied to these substances is justified by their properties. J. S. G. T.

Measurement of Solvation (Swelling) in Colloids. H. LÜERS and M. SCHNEIDER (*Kolloid Zeitsch.*, 1921, **28**, 1—4). —The authors have made a comparative study of Hofmeister's weight method, Fischer's volume method, and Wo. Ostwald's viscosimetric method for the determination of the amount of swelling of colloids. The measurements include determinations of the increase in weight of gelatin in water, the change in the viscosity of gliadin in lactic acid of various concentrations, the sedimentation height of barley flour, and the change in the viscosity of suspensions of barley flour. The results show that the three methods named furnish similar results, are generally applicable, and trustworthy. J. F. S.

The Limiting Size of Colloidal Particles in a Brownian Motion. BUNSAKU ARAKATSU and MITSUHARU FUKUDA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 179—182).—Sols of the metals gold, silver, copper, cadmium, zinc, tin, magnesium, nickel, aluminium,

platinum, and tungsten, prepared by Bredig's method, were examined by measuring the diameter of the smallest particle which could be found in a state of rest. The limiting size, which appeared to be the same for all the metals, was approximately $2\cdot6\ \mu$. In the case of cadmium, zinc, tin, and magnesium, the particles were all so small that no measurement could be effected. The effect of increasing the viscosity of the sol was examined by adding a concentrated solution of sugar or glycerol, measuring the viscosity, and then examining as before with the ultramicroscope. These experiments were made with gold and copper sols, and it was found in each case that by plotting the logarithm of the limiting size of the particle, a, against the viscosity, η, a straight line was obtained. For the gold sol, the relation can be expressed by $a\eta^{0\cdot229}=3\cdot5$, and for copper, $a\eta^{0\cdot249}=3\cdot4$. E. H. R.

Coagulation of Colloidal Solutions by Electrolytes: Influence of Concentration of Sol. E. F. BURTON and (MISS) E. BISHOP (*J. Physical Chem.*, 1920, **24**, 701—715).—The three aqueous colloidal solutions used were gum mastic sol, Bredig copper sol, and arsenious sulphide sol. The results show that the coagulative power of any given ion varies with the concentration of the disperse phase of the colloidal solution, as follows. For univalent ions, the concentration of ion necessary to produce coagulation increases with decreasing concentration of the colloid, this increase being very rapid with low concentrations of the colloid. For bivalent ions, the concentration of the ion necessary to produce coagulation is almost constant and independent of the concentration of the colloid. For tervalent ions, the concentration of ion necessary to produce coagulation varies almost directly with the concentration of the colloid.

The authors suggest that there are at least two properties of the system, made up of colloidal solution plus electrolyte, which have influence in determining the coagulating power of any ion. These two influences are such that they tend to counteract one another to a certain extent. One of them dominates the action of univalent ions, whilst the other dominates the action of tervalent ions. In the action of bivalent ions, the two influences seem to be nearly equalised. W. G.

Gold Numbers of Electrolyte-free Fractions of Albumin from Normal and Immune Serums and their Sensitising Action on Colloidal Suspensions. JOSEPH REITSTOTTER (*Kolloid Zeitsch.*, 1921, **28**, 20—24).—The gold number and the sensitising action of electrolyte-free albumin and paraglobulin on ferric hydroxide sols have been determined. The albumin fractions were prepared from the normal and immune serums of several animals by the electro-osmotic method. The albumins have the smallest gold number, and are followed in order by paraglobulin and euglobulin. It is shown that the gold number is not a characteristic constant in the case of anti-substances. Different antitoxic serums from the same type of animal have the

same gold number within the limits of the experimental accuracy, and different bactericidal serums have the same protective action toward colloidal gold as the normal serums. The gold number is independent of the nature of the serum. Different albumin fractions exhibit widely different sensitising actions on ferric hydroxide sols, but all albumin–ferric hydroxide sols are much more sensitive to electrolytes than the pure ferric hydroxide sols. Paraglobulin has a similar, but somewhat less marked, action than albumin. Paraglobulin antitoxic serums have a greater sensitising action than the normal or antibacterial serums, from which it is deduced that the specific anti-substances have a larger negative charge than the normal paraglobulin. It is possible to differentiate between paraglobulin and antitoxic serums by purely physico-chemical measurements without experiments on animals, and the sensitising action on ferric hydroxide sols may be regarded as a reaction for the anti-substances. J. F. S.

Three Phase Emulsions. H. Bechhold, L. Dede, and L. Reiner (*Kolloid Zeitsch.*, 1921, **28**, 6—19).—It is shown that pairs of immiscible liquids such as water–benzene and water–petroleum may be emulsified by shaking with alumina, zinc dust, or yeast. The emulsion formation depends on the size of the particles of the powder, its quantity, and on the addition of certain substances (emulsion promoters). The emulsifying power of the powder (emulsion former) increases to a maximum with decreasing size of the particles, and then decreases with a further decrease in the size of the particles; the more solid phase present the larger the amount of emulsion produced. The powder forms a sheath round the individual drops of the disperse phase, and prevents them coalescing, and consequently the greater the amount of powder the greater the surface which it can thus protect, and so the greater the amount of emulsion formed. The emulsion promoters must be soluble in one or both of the liquid phases. Benzene and water are not emulsified by shaking with alumina powder, but the addition of a few drops of such substances as pyridine, acetic acid, ethyl alcohol, sodium hydroxide, or sodium nitrate immediately causes emulsification. It is probable that the rôle of the emulsion promoter consists in some action influencing the wetting of the powder by the two liquid phases. The relative surface tension of the two liquids has no influence on the emulsification, and consequently the change of surface tension brought about by the emulsion promoter cannot have any effect on the emulsification. The systems named above have been examined, and the maximum quantity relationship for complete emulsification determined. It is shown that in general the maximum relationship lies between 60 to 80 volumes of the disperse phase to 20 to 40 of the dispersion medium. Theoretically, this relationship is deduced as 74 : 26. The volume of the emulsion is influenced by the density of the solid phase and that of both liquid phases. Large differences in the density bring about a diminution of the emulsion layer. J. F. S.

Influence of the Ionising Tension on Chemical Reactions in Gaseous Mixtures, particularly, in the case of the Inert Gases. FRANZ SKAUPY (*Zeitsch. Physik*, 1920, **1**, 49—50).—When freshly filled tubes of neon and argon are used for the first time the spectrum is always found to indicate the presence of carbon compounds. In the case of a neon tube the carbon spectrum vanishes in a few seconds, whilst in the case of an argon tube it persists for hours, but eventually disappears. The author explains the different behaviour as follows: the ionisation potential of carbon compounds lies between that of neon and argon, so that when the potential is applied to the neon tube the carbon compound takes up by preference the electrons, and is decomposed by them to form non-volatile derivatives, whilst with an argon tube the argon takes the electrons and the carbon compound is therefore only slowly destroyed. An analogous case is found in the purification of argon or neon from nitrogen by heating with a mixture of calcium chloride and carbide; in the latter case the reaction is much more rapid than in the former case. The explanation is similar to the foregoing explanation: the red hot calcium compounds emit electrons which ionise the nitrogen in preference to the neon; the nitrogen ions then react with the carbide, whilst in the other case they ionise the argon in preference to the nitrogen, and so the reaction is retarded. It would seem, therefore, that the inactive gases are capable of exerting an influence on the velocity of chemical reactions which are brought about by the presence of free ions. J. F. S.

Reversible Reactions of Carbon Monoxide on the Oxides of Iron. GEORGES CHAUDRON (*Compt. rend.*, 1921, **172**, 152—155).—Starting with ferric oxide and carbon monoxide, the author has studied the equilibria over a temperature range of 300—1000°. The ferric oxide is reduced to the magnetic oxide, and beyond this stage two reactions may occur. Below 580° there is a single system corresponding with the equation $Fe_3O_4 + 4CO \rightleftharpoons 4CO_2 + 3Fe$. Above 580° there are two equilibria before arriving at iron, namely, $Fe_3O_4 + CO \rightleftharpoons 3FeO + CO_2$ and $FeO + CO \rightleftharpoons Fe + CO_2$. The three solid phases co-exist in equilibrium at 580°. Below 580° ferrous oxide is unstable, and is transformed into a mixture of iron and the magnetic oxide, $4FeO \rightleftharpoons Fe_3O_4 + Fe$. W. G.

Binary Equilibria with Solid Carbon Dioxide. A. THIEL and E. SCHULTE (*Zeitsch. physikal. Chem.*, 1920, **96**, 312—342).—The binary systems between solid carbon dioxide and ethyl ether, ethyl chloride, methyl ether, chlorine, hydrogen sulphide, and carbon disulphide have been investigated. It is shown that in all cases the characteristic temperature of the three-phase system corresponds with the vapour pressure of pure carbon dioxide, and thereby it follows that in each case solid carbon dioxide constitutes the solid phase. The equilibrium temperature lies only so much below the sublimation temperature as corresponds with the amount of the second component in the vapour phase. J. F. S.

The Phenomena Presented by Allotropic Organic Substances in Contact with a Solvent. H. VIXSEBOXSE (*Rec. trav. chim.*, 1921, **40**, 1—29).—In a study of the keto-enolic tautomerism of benzoylcamphor the author finds that the results obtained by Meyer's method (A., 1911, i, 350, 832) in alcohol, acetic acid, acetone, ether, or toluene as solvents do not agree satisfactorily with the formula of van't Hoff as elaborated by Dimroth (A., 1911, ii, 31; 1913, ii, 763), which the author considers to be a particular case of a general formula obtained by Smits (A., 1915, ii, 750). Using instead measurements of optical activity (compare Forster, T., 1901, **79**, 987) in alcohol, acetone, and toluene as solvents at three different temperatures, the author obtains results which agree well with Smits's formula. The equilibria in the different solvents are enol/ketone equals 82/18 in toluene, 61/39 in alcohol, and 52/48 in acetone. The author calculates that the transition temperature at which $c_A/c_B = l_A/l_B$, and therefore $K = 1$, in other words, the temperature at which both forms can co-exist in the crystalline state, will be in the neighbourhood of $-83°$. W. G.

Non-mechanical Nature of Chemical Processes. M. POLANYI (*Zeitsch. Physik*, 1920, **1**, 337—344).—A mathematical paper, in which it is shown that so long as the deviations from the equi-partition principle cannot be explained without quanta, it appears to be objectless to represent chemical reactions in a mechanical manner. The dissociation of bromine takes place at least 300,000 times faster than is indicated by statistical mechanics.

J. F. S.

Origin of Chemical Energy. M. POLANYI (*Zeitsch. Physik*, 1920, **3**, 31—35. Compare preceding abstract).—It has been shown previously that chemical reactions do not occur at the expense of the kinetic energy of the reacting substances, but obtain the energy required for the reaction from the aether. The present paper shows that this energy is not drawn from the aether as heat radiation, and that such a source of energy is not possible or in keeping with dark reactions. The author considers the nature of the energy taken up in accordance with the hypothesis, and puts forward a further hypothesis as to the nature of the energy. The emission of radiation consists in a quantum spring made by an electron coupled with a quantum spring of the aether. The first spring is followed by a loss of energy which covers the energy used by the coupled quantum spring of the aether. The absorption of radiation consists in the reversal of this process. J. F. S.

Dynamic Quantum Weight, Nernst's Theorem, and Gibbs's Paradox. W. SCHOTTKY (*Physikal. Zeitsch.*, 1921, **22**, 1—11).—A theoretical paper, in which the influence of the dynamic quantum weight of solid substances and gaseous molecules on the chemical constant in vapour pressure and reaction equilibria is investigated for those cases where the weight differs from unity.

The weight unity is deduced for the lowest quantum condition from certain theoretical and experimental data, and this affords a confirmation of the Nernst theorem. The Nernst theorem cannot be extended to the higher quantum conditions of gaseous molecules, since here quantum weights which differ from unity certainly appear. A consideration of this case from the point of view of Gibbs's mixture paradox shows that this paradox has its foundation in the cellular structure of the phase volume. J. F. S.

Theory of Equations of Condition. I. MARIO BASTO WAGNER (*Zeitsch. physikal. Chem.*, 1920, **96**, 483—497).—In a previous paper (*Ann. Physik*, 1914, **45**) the author developed two equations of condition which have the form:

$$pv = RT\left[2 - e^{-n/RT\int_0^\infty F(r)dr} + b/v + a_1 b^2/v^2 + \ldots\right]$$

and $pv =$

$$RTe^{-n/RT\int_0^\infty F(r)dr}\left[1 + \left(b/v \, . \, e^{-n/RT\int_0^\infty F(r)dr}\right) + a_1\left(b/v \, . \, e^{-n/RT\int_0^\infty F(r)dr}\right)^2 + \ldots\right]$$

In the paper quoted the value of $\int_0^\infty F(r)dr$ was not determined. The author now deduces the first of the above formula by the "Wall" method, and then proceeds to evaluate $\int_0^\infty F(r)dr$, which is shown to have the value:

$$n\int_0^\infty F(r)dr = RT\log_e RT/p(v-b) + RTv/(v-b) - RT + bp.$$

J. F. S.

The Significance of Velocity Constants from the Point of View of the Quantum Theory. MAX TRAUTZ (*Zeitsch. Physik*, 1920, **2**, 117—126, 296).—A mathematical investigation from the point of view of the quantum hypothesis of the two factors composing the velocity constant characteristic of a reaction—the frequency or impact number and the activity or yield factor. The work is concerned principally with the former, and includes a discussion from the point of view of the quantum hypothesis of the temperature-coefficient of the velocity of reaction. J. S. G. T.

Influence of Colloids on the Rate of Reactions Involving Gases. I. Decomposition of Hydroxylamine in the Presence of Colloidal Platinum. ALEXANDER FINDLAY and WILLIAM THOMAS (T., 1921, **119**, 170—176)

Kinetics of the Reaction between Hydrogen Peroxide and Iodine. E. ABEL (*Zeitsch. physikal. Chem.*, 1920, **96**, 1—179).—The reaction between hydrogen peroxide and iodine which is represented by the equation $H_2O_2 + I_2 = 2HI + O_2$ (1) is on account of the similarity of the reaction substances always accom-

panied by the reaction $H_2O_2+2HI=I_2+2H_2O$ (2), whereby a complicated system is set up which is rendered more difficult of investigation because reaction (1) only takes place under otherwise suitable conditions between relatively narrow limits of hydrogen-ion concentration, namely, between $H^{\cdot}=10^{-6}$—10^{-7}, with a velocity which is experimentally measurable. The velocity was ascertained by measuring the volume of oxygen evolved, and to prevent supersaturation large volumes of the reaction mixture were rapidly stirred. In order that the hydrogen-ion concentration should be maintained within the necessary limits, sodium acetate and acetic acid were added to the reaction mixture. The total changes occurring are represented by the scheme:

$$\overset{(a-x_1-x_2)}{H_2O_2} + \overset{(b-x_1+x_2)}{I_2} + \overset{(d-x_1+x_2)}{2CH_3{\cdot}CO_2Na} \longrightarrow O_2+2NaI+2CH_3{\cdot}CO_2H \quad (1')$$

$$\overset{(a-x_1-x_2)}{H_2O_2} + \overset{(e+x_1-x_2)}{2CH_3{\cdot}CO_2H} + \overset{(c+x_1-x_2)}{2NaI} \longrightarrow I_2+2CH_3{\cdot}CO_2Na+2H_2O \quad (2'),$$

where the bracketed quantities represent the momentary concentrations, x_1 and x_2 the progress of the reactions (1′) and (2′) at the time t. In most cases the reactions were carried out with $0{\cdot}4N$-sodium acetate. It is shown that the velocity of the reaction between hydrogen peroxide and iodine is strictly proportional to the concentration of the peroxide. It is also proportional to the concentration of the I_3' ions, but with concentrations of sodium acetate greater than $1{\cdot}0N$ the velocity is a little less than that required for strict proportionality. The reaction velocity is to a degree dependent on the products of the reaction in the sense that with increasing concentration of hydrogen ions and iodine ions it decreases. The hydrogen-ion concentration appears in the equilibrium equation raised to the power q, which has a value for the present experiment between -1 and -2, and which varies in the sense that with increasing I' concentration it increases, and in the concentrations of $I'=0$ to about $I'=0{\cdot}1N$ the value of q reaches a stationary value of $-1{\cdot}50$; with a further increase in the I' concentration the value of q decreases toward -2. In this region the variation of q between $-1{\cdot}0$ and $-1{\cdot}50$ with I' concentration can be well represented by the e function, $q=-1{\cdot}50+0{\cdot}50e^{-402{\cdot}5[I']}$. The iodine-ion concentration appears in the equation raised to a power which lies between -1 and -2. Apart from the above-mentioned connexion between the I' concentration and the velocity, the "order" of reactions (1) and (1′) in respect of the I' concentration may be so formulated that it passes through a minimum which lies at about -4 for very small concentrations of I' ions. On either side of this minimum the order increases, on the side of decreasing I' steeply toward -2 or perhaps to -1, and on the side of increasing I' concentration more slowly towards -1. This change in the index of the I' concentration, which represents the concentration range of $0{\cdot}001N$—$0{\cdot}1N$, may be represented by whole number stationary points ($-4{\cdot}0$, $-3{\cdot}0$, $-2{\cdot}0$, $-1{\cdot}0$), which represent practically sudden changes in

the character of the reaction and which subdivide the concentration range into four parts (I, II, III, IV), which may be easily fitted in with the four indexes. The approximate limits of these four parts, as well as the corresponding velocity-coefficients $\bar{k}_1$ for unit concentration of the reacting substances with 0·4N-sodium acetate at 25°, are given in a short table in the paper, and may be shortly reproduced, thus: region I, I′(0·001 – 0·004)N, $p = -4{\cdot}0$, $k' = 4{\cdot}6 \times 10^{-17}$; II, I′(0·004 – 0·008)$N$, $p = -3{\cdot}0$, $\bar{k}_1 = 13{\cdot}3 \times 10^{-15}$; III, I′(0·009 – 0·02)$N$, $p = -2{\cdot}0$, $k' = 15{\cdot}1 \times 10^{-18}$; and IV, I′(0·03 – 0·1)$N$, $p = -1{\cdot}0$, $k' = 5{\cdot}8 \times 10^{-11}$. Under otherwise constant conditions the velocity increases with increasing acetate content; for a given I′ concentration this increase may be represented by the expression: $\bar{k}_{1[\mathrm{I}']=0\cdot3 \atop \lim[\mathrm{I}_3']=0} = [2{\cdot}67 + 12{\cdot}0\alpha'(CH_3{\cdot}CO_2Na) + 10{\cdot}8(1 - \alpha')^2(CH_3{\cdot}CO_2Na)^2] \times 10^{-11}$, where α' is the degree of dissociation and ($CH_3{\cdot}CO_2Na$) indicates the total concentration of sodium acetate in gram-mols. per litre. More generally, within the region I—IV the time law of reaction I′ is given by the simultaneous differential equations $dx_1/dt = k_{1\,\mathrm{I \cdot II \cdot III . IV}}\{(a - x_1 - x_2)[\mathrm{I}_3']_t\}/[\mathrm{I}']_t^{4:3:2:1}\{[K_K(e + x_1 - x_2)/a'd]^{1\cdot50-0\cdot50_e - 402\cdot5[\mathrm{I}']_t}\}$ and $dx_2/dt = \underline{k}_2(a - x_1 - x_2)[\mathrm{I}']_t$, where the values for k_1 are those given above, $\bar{k}_2$ is the equilibrium constant of the H_2O_2 – I′ reaction (0·78), and $[\mathrm{I}']_t$ and $[\mathrm{I}_3']_t$ represent the concentrations of I′ and I_3' ions, and are obtained from the tri-iodide equilibrium at time t for an iodide concentration $(c + x_1 - x_2)$ and iodine concentration $(b - x + x_2)$, and K_k is the dissociation constant of acetic acid ($1{\cdot}8 \times 10^{-5}$). These equations have been tested on a series of examples and substantiated. The above relationships indicate that the $H_2O_2 - I_2$ reaction takes place with respect to H˙ and I′ negatively auto-catalytically, but in combination with the H_2O_2 – I′ reaction in relation to iodine positively; in respect of H˙ and I′, however, the nature depends on the conditions, that is, as $x_1 >$ or $< x_2$ negative or positive catalytic. The variations of the reaction H_2O_2 – HI from the strictly bimolecular reaction which are found in the literature are all to be explained by the presence of the simultaneous reaction $H_2O_2 - I_2$.

J. F. S.

Removal of Halogens from some Organic Compounds. ARVID HJ. HEDELIUS (*Zeitsch. physikal. Chem.*, 1920, **96**, 343—366).—The velocity of reaction between solutions of sodium hydroxide and a series of halogen substitution products has been investigated at a series of temperatures. The measurements were all carried out in aqueous solutions, and from the results the constant A of the Arrhenius temperature formula,

$$K_{T_1} = K_{T_0} \cdot e^{(A[T_1 - T_0]/2T_0T_1)},$$

was calculated. The following data are recorded: monochloroacetic acid, 55°, $K = 2{\cdot}05 \times 10^{-3}$; 65°, $K = 6{\cdot}08 \times 10^{-3}$; 80°, $K = 23{\cdot}9 \times 10^{-3}$; 90°, $K = 61{\cdot}8 \times 10^{-3}$; $A = 23{,}000$; monobromoacetic acid, 65°, $K = 151 \times 10^{-3}$; 75°, $K = 365 \times 10^{-3}$; $A = 20{,}600$;

ethylene dibromide (first stage), 30°, $K=113\times10^{-3}$; 45°, 649×10^{-3}; $A=22{,}000$; (second stage), 75°, $K=2{\cdot}8\times10^{-3}$; α-bromoacetoacetic ester, 40°, $K=$ ca. 800×10^{-3}. Experiments were also made with α-bromopropionic acid and monochloroacetone. In the case of α-bromopropionic acid, it was impossible to obtain a velocity constant, since the reaction takes place simultaneously in several directions. The influence of alcohol, water, and acetone on the velocity of the reaction has been examined. In the case of monochloroacetone, the constant was determined at 0°, as the reaction is extremely rapid, even at this temperature, and the constant shows a decided progression. J. F. S.

Kinetics of the Ketonic Decomposition of Acetoacetic Acid. ERIK M. P. WIDMARK (*Acta med. Scandinav.*, 1920, **53**, 393—421; from *Chem. Zentr.*, 1921, i, 9—10).—The course of the reaction is followed by estimation of the carbon dioxide evolved according to Winckler's method (precipitation of barium carbonate). The necessary acetoacetic acid is prepared by hydrolysis of technical ethyl acetoacetate by alkali hydroxide, this process being complete before acetone is produced in measurable amount. The formation of acetone has been investigated in acid and alkaline solution; in the latter, practically only the electrolytically dissociated anion of acetoacetic acid is present, since the salt is extensively dissociated into $Na^{\cdot}$ and $CH_3{\cdot}CO{\cdot}CH_2{\cdot}CO_2'$. In strongly acid solution, on the other hand, the acid is present as such, since electrolytic dissociation can be neglected. It is found that the undissociated and dissociated acids exhibit greatly differing rates of decomposition, that of the former being about fifty times the greater. In alkaline solution, formation of acetone occurs at the rate of decomposition of the anion, the velocity of which is calculated from a series of concordant observations to be 0·00008 at 37°; in strong mineral acid solution, on the other hand, it occurs at the rate of decomposition of the acid itself, the constant of which is calculated to be 0·0042 at 37°. As is to be expected, the reaction is of the first order in either case. In almost neutral solutions, in which the acetoacetic acid is partly dissociated, the rate of decomposition depends on the degree of electrolytic dissociation, and can be calculated from the expression $\alpha V_1-(1-\alpha)V_m$ (V_1 and V_m = constants of decomposition of the ion and undissociated acid respectively; α = degree of dissociation). This expression is valid for all concentrations of hydrogen ions. On the other hand, the degree of dissociation depends on the hydrogen-ion concentration, which varies with the progress of the action, since acetoacetic acid is decomposed. In spite of these complications, the author has succeeded in establishing the validity of his hypothesis; in nearly neutral solution, the velocity constants gradually diminish, in consequence of falling hydrogen-ion concentration, and the extent to which this occurs harmonises well with the theoretical calculations. On the other hand, the hydrogen-ion concentration can be maintained constant by the addition of acetic acid and sodium acetate, and in this case the

velocity constants become uniform. Under these conditions, the hydrogen-ion concentration can be estimated by a study of the rate of reaction, and the value thus found is identical with that determined by electromotive measurements. H. W.

Kinetics of the Reduction of Azo-compounds. HEINRICH GOLDSCHMIDT and ASBJÖRN BRAANAAS (*Zeitsch. physikal. Chem.*, 1920, **96**, 180—213).—The velocity of the reduction of acid solutions of a number of azo-compounds by means of stannous chloride or stannous bromide has been followed at 25° by means of colour changes, which were observed with a Dubosq colorimeter. The reduction of azobenzenetrimethylammonium chloride, azobenzene-*mm'*-disulphonic acid, *p*-dimethylaminoazobenzene, *p*-diethylaminoazobenzene, *p*-aminoazobenzene, methyl-orange, β-naphthylaminoazobenzenesulphonic acid, benzeneazonaphthylamine-4 : 7-disulphonic acid, naphthionic-azobenzenesulphonic acid, *p*-tolueneazo-*p*-toluidine, methylene-blue, chrysoidine-T, *p*-oxyazobenzene, tropæolin-T, α-naphtholazobenzenesulphonic acid, β-naphtholazobenzenesulphonic acid, benzeneazo-β-naphtholsulphonic acid-S, benzeneazo-β-naphtholdisulphonic acid-R, and *m*-xyleneazo-β-naphtholdisulphonic acid-R in hydrochloric acid (0·1—1·0*N*) in the absence of, and in the presence of, various concentrations of sodium chloride by solutions of stannous chloride of various concentrations has been investigated. In the case of six of the above-named compounds, the reduction has been effected with stannous bromide in hydrobromic acid solution. In every case, the reduction is found to be a bimolecular reaction, since the velocity of reduction is proportional to the tin concentration. In those cases where the azo-compound is broken up into two amino-derivatives by the addition of four hydrogen atoms, the reaction takes place in two stages. The first stage, which occurs with a measurable velocity, consists in the reduction to a hydrazo-compound, which is then further reduced with an infinitely large velocity. In most cases, the reduction takes place, as in the case of nitro-compounds, by means of the small amount of $SnCl_3'$ which always exists in acid solutions of stannous salts, but, in addition, the stannous salt can exercise a reducing action. Both actions may occur simultaneously. As examples of the reduction by the $SnCl_3$ ion, the cases of β-naphthol-orange and aminoazotoluene may be quoted, whilst benzeneazo-β-naphtholsulphonic acid-S, benzeneazo-β-naphtholdisulphonic acid-R, and *m*-xyleneazo-β-naphtholdisulphonic acid-R furnish examples of the combined action. In the first case, the velocity constant is given by $k=K[Hlg']$, and is proportional to the halogen-ion concentration. In the second case, the formula is $k=K_1+K_2[Hlg']$. The halogen acid can be replaced by the metallic haloids without change of the velocity of reaction; this is in keeping with the above formulæ. In many cases it is not the azo-compound itself, but a small concentration of the additive compound of the azo-compound with the halogen acid, which undergoes the primary reduction. When this additive compound reacts with the $SnCl_3$ ion, the reaction velocity is given by the formula

$k=K[H^{\cdot}][Hlg]^2$, which, in the absence of metallic haloid, becomes $k=K[HlgH]^3$. These formulæ were obtained for the substances azobenzenetrimethylammonium chloride, azobenzene-*mm'*-disulphonic acid, and the four *p*-aminoazo-compounds. In these cases, an addition of metallic haloid increases the velocity, but not to the same extent as the addition of an equivalent quantity of hydrogen haloid would do. Cases were observed where the reaction follows the equation $k=K_1[Cl'] + k_2[H^{\cdot}][Cl]^2$, in particular that of oxyazobenzene. In this case, the reaction takes place between the azo-compound itself and its additive compound with $SnHlg_3'$. The investigation of α-naphthol-orange indicates that the tin haloid reacts with the acid additive compound. If this were the only reaction, the course would be represented by $k=K[H^{\cdot}][Cl']$, but $SnHlg_3'$ also appears to react, so that the equation must be changed to $k=K_1[H^{\cdot}][Hlg'] + K_2[H^{\cdot}][Hlg]^2$. Stannous bromide reduces more rapidly than stannous chloride, but not regularly; the relationship between the two reducing actions varies very much in different cases, but in all cases the course of the reactions are identical. The catalytic action of the halogen and hydrogen ions is not dependent to any extent on the degree of dissociation, but appears to be proportional to the total concentration of the strong electrolyte. J. F. S.

The Catalytic Decomposition of Hydrogen Peroxide by Sodium Iodide in Mixed Solvents. VAN L. BOHNSON (*J. Physical Chem.*, 1920, **24**, 677—700).—A study of the velocity of catalytic decomposition of hydrogen peroxide by sodium iodide, as influenced by the medium in which it takes place. The solvents used were different aqueous mixtures of methyl, ethyl, *n*-propyl, *iso*butyl and amyl alcohols, glycerol, and pyridine. The solvents apparently did not undergo oxidation, and the decomposition of the hydrogen peroxide, which was measured gasometrically, was complete. The relative velocity of reaction in the pure solvents may be expressed by the following constants: methyl alcohol 23, ethyl alcohol 45, *n*-propyl alcohol 164, *iso*butyl alcohol 397, amyl alcohol 537, glycerol 376, pyridine 7, water 128·7, and for a gelatin solution with marked viscosity 94·3. There is apparently no relation between the velocity of the reaction and the dielectric constant, viscosity, or surface tension of the pure solvent. In some cases, the curves for the reaction velocity in aqueous mixtures showed minima, which, however, did not correspond with the minima in the fluidity curves.

The solvent appears to exert a specific influence on the velocity of a reaction, this effect being probably the resultant of a number of other effects, due to association of the solvent, its viscosity, and surface tension, the dissociation of the catalyst, and a possible reaction between solvent and dissolved substances. W. G.

Hydrogenation of Aromatic Compounds by the Help of Platinum. IV. The Dependence of Catalytic Hydrogenation on the Presence of Oxygen. RICHARD WILLSTÄTTER and ERNST WALDSCHMIDT-LEITZ (*Ber.*, 1921, **54**, [*B*], 113—138. Compare Willstätter and Jaquet, A., 1918, i, 391).—In a previous

communication (*loc. cit.*), the authors have been led to the conclusion that platinum itself, and platinum loaded with oxygen, are to be regarded as distinct catalysts, but by the former term the metal is understood as not having been specially treated with oxygen. It is now shown, however, that platinum and palladium, whether as spongy metal or as colloid, are incapable of bringing about the hydrogenation of even the most reactive olefines if they have been freed completely from oxygen. Hydrogenations, dehydrogenations, and hydrogen peroxide catalyses by the platinum metals therefore depend alike on the presence of compounds of the metal and oxygen. Sabatier's conception of catalytic hydrogenation by finely divided metals as due to the formation of an unstable hydride must therefore be abandoned, since the intermediate compounds contain both hydrogen and oxygen (compare, also, Hofmann and Ebert, A., 1917, ii, 25; Hofmann and Zipfel, A., 1920, ii, 240). Confirmation of this view is found in the observations of Mond, Ramsay, and Shields, who, however, do not express any definite opinion as to the manner in which the gases are present. Generally, however, it appears to have been assumed that hydrogen, and probably oxygen, are present in the monatomic form, but the authors' experiments indicate that the former is present in oxidised platinum and palladium in a more readily dissociable form than in the hydrides of these metals. It appears more probable that the oxidised metal reacts with hydrogen in such a manner as to yield a compound, which is both a peroxide (or oxide) and hydride, and that the transference of hydrogen depends on the metal functioning alternately as a bi- and quadri-valent element: (i) $Pt + O_2 \rightleftharpoons Pt{<}\overset{O}{\underset{O}{|}} . Pt{<}\overset{O}{\underset{O}{|}} + H_2O = Pt{<}\begin{matrix}O{\cdot}OH\\OH\end{matrix}$; (ii) $Pt{<}\overset{O}{\underset{O}{|}}$ (or hydrate) $+ H_2 \rightleftharpoons \begin{matrix}H\\H\end{matrix}{>}Pt{<}\overset{O}{\underset{O}{|}}$ (or hydrate).

It is pointed out that the hydrogenation of aromatic carboxylic acids by means of sodium amalgam takes place in a manner which differs from that of all other methods of reduction, since the partly reduced, and therefore olefinic, acids are less readily attacked than the parent substances. The phenomenon resembles that of paralysis of the catalyst, and is being investigated further.

The preparation of spongy platinum by the reduction of chloroplatinic acid by formaldehyde in alkaline solution (Willstätter and Hatt, A., 1912, i, 545) is improved by the substitution of potassium for sodium hydroxide, since the slower reduction, due to the formation of the sparingly soluble potassium platinichloride, allows the temperature to be more readily controlled. The catalyst may be freed completely from oxygen by treating its suspension in glacial acetic acid with hydrogen for thirty hours at the atmospheric temperature, or eight hours at 50—60°. It is then completely insoluble in hydrochloric acid, and does not liberate iodine from acidified potassium iodide solution. It is incapable of causing the hydrogenation of benzene, *cyclo*hexene, limonene, or pyrrole, but acquires this power if shaken for a short period with

air. Deoxidation of the catalyst also invariably takes place during the course of hydrogenation with greater or less rapidity, according to the particular substance under investigation, and the "poisoning" action of certain substances, such as glycerol and thiophen, is certainly due to the same cause, but it is doubtful if all cases of paralysis of the catalyst can be explained by the removal of oxygen. Removal of oxygen by diminution of pressure can only be accomplished with difficulty, but, by continuous exhaustion with a high vacuum pump, it was found possible to get a nearly inactive preparation.

Hydrogenation of a di-olefine could not be effected in the presence of palladium-black which had been freed completely from oxygen, whilst oxygen-free colloidal palladium was also found to be inactive.

Catalytic hydrogenation in the presence of nickel preparations has been regarded by Sabatier ("La Catalyse," 1913, p. 115) as exclusively a property of the metal; the function of the oxides of nickel has, however, been recognised by Bedford and Erdmann (A., 1913, i, 701), whilst Brochet (A., 1914, i, 645) has expressed the opinion that pure nickel is catalytically inactive. The authors' experiments show that whilst nickelous oxide and nickel suboxide are active, the metal itself, even when prepared at the lowest possible temperature, is inactive in the presence of sodium cinnamate, oleic acid, or methyl oleate, but acquires activity when primed with oxygen, the quantity of the latter which is required being very small.

The explanation of the rôle of oxygen in catalytic hydrogenations in the presence of platinum enables the technique of the operation to be improved considerably, since the catalyst is reactivated by oxygen as soon as it shows signs of diminished activity, and "poisoning" is circumvented either by increasing the amount of platinum or by suitable treatment with oxygen. Priming is particularly useful when only small quantities of catalyst are used or when it is employed frequently. According to the authors' experiments, the use of spongy palladium has no advantage over that of platinum (contrast Wieland, A., 1912, i, 956), whilst, on the other hand, the greater absorption capacity of the former for hydrogen renders more difficult its reactivation by oxygen to such an extent that the procedure becomes either dangerous or cumbersome.

According to Böeseken and his co-workers (A., 1916, ii, 239; 1918, ii, 73), the process of catalytic reduction by finely divided metals depends on a diffusion phenomenon which precedes the actual hydrogenation and controls the rate of reaction, since it is assumed to take place more slowly than the actual reduction. This hypothesis does not explain the very different rates of hydrogenation of benzene and *cyclo*hexene under similar conditions, since it is improbable that the diffusion process can differ greatly in the two cases, or the cessation or delay after addition of a molecule of hydrogen to cinnamic acid. It appears more probable that the rates observed in catalytic hydrogenations depend on two

factors: (i) the actual velocity of hydrogenation, and (ii) the decrease in the amount of catalyst, since the spongy or colloidal metal, which contains oxygen, is reduced to the inactive metallic hydride, whilst it transfers hydrogen to the substance under investigation. Since the loss of oxygen from the catalyst frequently seems to take place with uniform rapidity, it is possible to compare the activities of unsaturated substances by comparison of the volumes of hydrogen which are transferred to them by a given weight of oxygenated platinum before the latter becomes exhausted. Alternatively, the initial rates of hydrogenation may be compared. The results obtained by the two methods are similar.

Substances may be divided into three groups, according to their rate of hydrogenation: (i) ethylenic compounds, with which the process occurs so readily that deoxygenation is scarcely noticeable, and need not be taken into account if the catalyst is only used once; (ii) simple aromatic substances, which are moderately rapidly hydrogenated (but much more slowly than the olefines), and with which removal of oxygen may cause a great decrease in the activity of small amounts of catalyst; and (iii) difficultly hydrogenated substances, which can only be reduced after activation by the method of Willstätter and Jaquet (*loc. cit.*); the rate of hydrogenation is so small that deoxygenation of the platinum occurs with inconvenient rapidity. Polynuclear aromatic compounds, such as *o*-benzylbenzoic acid, *o*-naphthoylbenzoic acid, and substances which directly remove oxygen from the platinum, belong to this class.

The peculiar suitability of glacial acetic acid as a solvent in catalytic hydrogenations is not due to a greater solubility of hydrogen in this substance than in the other media frequently employed. H. W.

A New Periodic Relationship between the Atomic Weights of the Chemical Elements. V. Calculation of Rydberg's Constant. KARL FEHRLE (*Physikal. Zeitsch.*, 1921, **22**, 60—62. Compare A., 1920, ii, 303, 540, 749).—A theoretical paper, in which it is shown that series spectra are due to tensions, which are due to the incomplete resonance between the vibrations of the atoms of a molecule and those of complexes of a number of n^4 molecules, when n indicates any whole number. The energy of the tension is equal to one-half of the difference of the energy of rotation of the molecule, which is produced when these change their angular velocity by an amount which would be necessary to produce resonance with the complexes under consideration, and the energy of the emitted radiation equal to the change of energy accompanying changes in the complex. The relationship of the angular velocities is the same as when all the atoms are arranged on the surface of a single sphere. On the basis of the above, the atom model and the unchanged constants of the radiation formula of the previous work, it is shown that the portion of the formula which is variable for a given element is identical with Bohr's formula. The constants,

although they contain completely different quantities and are derived from a different point of view, are identical with Rydberg's constants to the second place of decimals. J. F. S.

Bohr's Atomic Model and the Theory of Relativity. K. FÖRSTERLING (*Zeitsch. Physik*, 1920, **3**, 404—407).—A theoretical paper, in which it is shown from the Bohr frequency conditions and perfectly general assumptions that just those displacements of the spectrum lines occur which are demanded by the theory of relativity. J. F. S.

Spatial Atomic Models. ADOLF SMEKAL (*Zeitsch. Physik*, 1920, **1**, 309—319).—A theoretical paper, in which the existence of an electron ring or an electron sheath in the atom is discussed. J. F. S.

Dynamics of Spatial Atomic Structure. A. LANDÉ (*Zeitsch. Physik*, 1920, **2**, 83—86).—The author applies the analysis developed in a previous paper (A., 1920, ii, 540) in connexion with the motion of four electrons arranged tetrahedrally about a nuclear charge to the cases of (*a*) eight electrons spatially distributed in cubical formation about a large nuclear charge, (*b*) six electrons rhombohedrally distributed about the nucleus, and (*c*) three electrons similarly arranged with regard to the nucleus. The characteristics of the various orbits, their inclinations to one another, etc., are discussed. The orbits of the spatially distributed electrons are analogous to the Keplerian orbits deduced by Sommerfeld by the application of the principle of relativity. A spatial distribution of four electrons, the effect of neighbouring electrons being neglected, is less stable than a plane ring formation of four electrons, whereas the opposite is the case where six electrons are concerned. J. S. G. T.

Size of Atoms. A. LANDÉ (*Zeitsch. Physik*, 1920, **2**, 87—89). —Values for the radii of the alkali and halogen ions deduced from the cubical structure of alkali-halogen salts are not in agreement with the more certain values deduced from the consideration of the *X*-ray and ordinary spectra series of lines of these elements. This discrepancy may be removed by assuming that in neutral alkali atoms the ions enclosed within the valency electrons and arranged so as to produce cubical symmetry move in circular orbits, while a large association of elliptic orbits possessing cubical symmetry occurs. A similar assumption may be made in the case of the atoms of the inert gases and negative halogen ions. J. S. G. T.

Cubical Atoms, the Periodic System and Molecular Structure. A. LANDÉ (*Zeitsch. Physik*, 1920, **2**, 380—404).— The orbits of four and eight electrons arranged so as to afford cubical symmetry are discussed. Any number of electrons may be

arranged so as to afford a lower order of symmetry, and the characteristics of the respective orbits about a nuclear charge are discussed. The orbits of individual electrons are approximately circles or Keplerian ellipses. The orbits affording cubical symmetry, in the case of eight electrons, have been shown by Madelung and Landé to afford a more stable configuration than a plane ring of eight electrons. In the case of the ionised alkalis, the cubical formation is considerably more stable than any other configuration. The neutral sodium atom would be represented by nine electrons rotating about a nuclear charge equal to $9e$. The nine electrons would be arranged in a formation of eight inner electrons in cubical formation and an outer orbit described by the remaining electron. Such a disposition would be characterised by possessing less energy than another possible stable arrangement of five inner and four outer electrons. From the consideration of such a formation, the value of the radius of the sodium ion is found to be $0{\cdot}605 \times 10^{-8}$ cm., in agreement with value $0{\cdot}517 \times 10^{-8}$ cm. found by Fajans and Herzfeld from crystal lattice results. In like manner the respective radii of the neon, fluorine, and oxygen ions are found to be $0{\cdot}714 \times 10^{-8}$ cm., $0{\cdot}875 \times 10^{-8}$ cm., and $2{\cdot}2 \times 10^{-8}$ cm. The radius of the neutral carbon atom is $1{\cdot}30 \times 10^{-8}$ cm. The ionisation potential for neon is calculated as 23·8 volts, a value in agreement with anticipations based on the values 15·1 volts and 17 volts determined by Holst and Hoopmanns, and Horton and Davies respectively for argon. The electronic affinity for the fluorine atom is calculated, and is found to be 132 Cal. per mol., in agreement with the series of values 119, 84, and 77 Cal. per mol. found by Born (A., 1920, ii, 156) for the respective electronic affinities of chlorine, bromine, and iodine. The heat of ionisation of HF is calculated and found to be 350 Cal. per mol. This value is in agreement with the respective values 320, 311, and 302 Cals. per mol. deduced by Born (*loc. cit.*) from thermochemical and physical data in the cases of hydrogen chloride, bromide, and iodide. The nuclear distance for hydrogen fluoride is calculated and found to be $0{\cdot}945 \times 10^{-8}$ cm., in agreement with the value $0{\cdot}92 \times 10^{-8}$ cm. deduced by Krazer. The heat of ionisation of water is found to be 533 Cals. per mol. and the nuclear distance $2{\cdot}03 \times 10^{-8}$ cm. J. S. G. T.

A Dynamical Model of a Cubical Atom. E. Madelung and A. Landé (*Zeitsch. Physik*, 1920, **2**, 230—235).—An atomic model composed of eight electrons arranged in the manner previously described (preceding abstract) so as to afford cubical symmetry is characterised by the fact that the intrinsic potential energy of such an atom is greater than that of a plane ring of eight electrons, and, moreover, the orbital perturbations produced by the action of an impressed force are of a much higher order of magnitude than that of the latter. These defects are absent from an atomic model constituted of two interpenetrating tetrahedral models, and the dynamics of such an atomic model are investigated mathematically.

J. S. G. T.

The Constitution of Atoms. ORME MASSON (*Phil. Mag.*, 1921, [vi], **41**, 281—285).—The word *baron* (Greek, βαρος, weight) is suggested for the positively charged particles contained in the atoms. Rutherford, in a footnote, remarks that the word *proton* has met with considerable approval as the name for this elementary atomic constituent. The symbol b denoting one boron, and e one electronic charge, the formula $(b_2e)_N(be)_n$, where N is the appropriate atomic number, and n has any appropriate value from 0 to 54, represents the constitution of the respective nuclei of all the elements from He to U. In the case of the elements He, C, N, O, S, the lower isotopes of B, Ne, Si, and Ar, and probably the lower isotopes of Li, Mg, Ca, and some other light elements, $n=0$. For hydrogen, $n=-1$. A neutral atom has the formula $[(b_2e)_N(be)_n]e_N$. The notation is applied to the sub-atomic reactions accompanying the emission of an α-particle, the emission of a β-ray, and the bombardment of light atoms by swift α-particles [p should be substituted for b in the above formulæ if the name *proton* is adopted]. J. S. G. T.

The Hydrogen Atom, Atomic Ether, and Planck's Quantum. L. ZEHNDER (*Vierteljahrschr., naturf. Ges. Zürich*, 1920, **65**, 59—92; from *Chem. Zentr.*, 1921, i, 236).—According to the author, the atomic aether surrounds the earth as an aether shell and thus explains the negative result of the Michelson-Morley experiment. In a similar manner aether masses are supposed to surround the atoms as condensed layers. The presumably spherical hydrogen atom enclosed in a shell of this type may exhibit two types of elastic oscillation when it collides with a second hydrogen atom, and these together correspond with optical observations. The mass of the individual atom of aether is calculated to be about 1/20,000th part of that of an electron. The oscillation in the atomic nucleus and aether shell, on the one hand, and the vibrations on the other are illustrated by Riecke's double pendulum. The oscillations may either be regarded as elastic or electric. Bohr's electric interpretation can be improved if account is taken of the vibrations. According to Hamilton's principle, Planck's quantum is connected with the addition of an aether atom to the aether shell. H. W.

The Sizes of the Kations of the Alkali Metals. RICHARD LORENZ (*Zeitsch. Physik*, 1920, **2**, 175—180).—The respective diameters of the ions of the alkali metals lithium, sodium, potassium, rubidium, and cæsium derived from the work of various authors (Born, Landé, Born and Lorenz, Heydweiller) are tabulated. Such tabulated values include the following: R_A, the radius deduced from the atomic volume: R_W, the value deduced from the value of the heat of hydration; R_B, the radius deduced from considerations of ionic mobility employing the Stokes-Born formula; R_G, the value deduced from the space-lattice constant; R_R, the value deduced from considerations of ionic refraction; R_D, the radius deduced from diffusion of the alkali metals in mercury, employing the Stokes-Einstein formula; $R_{\psi(0\cdot 25)}$, the value obtained on the assumption

that the ions occupy the smallest possible fraction, 0·25, of the total volume of the atom; and R'_W the values deduced from the corresponding values, R_W, by deducting therefrom the radius $0·45 \times 10^{-8}$ cm., a correction pointed out by Born. The values of R_R and R_G are in good agreement. The values of R_W and R_B are respectively greater and less than the corresponding values of R_G or R_R. The values $R_{\psi(0·25)}$ and R'_W are in very close agreement, and probably represent very approximately the radii of the respective ions of the alkali metals. For lithium, sodium, potassium, rubidium, cæsium, the respective values of $R_{\psi(0·25)}$ in 10^{-8} cm. are 1·09, 1·33, 1·66, 1·78, 1·92. The respective values of R'_W are 1·04, 1·14, 1·55, 1·79, and 1·77. J. S. G. T.

Proximity of Atoms in Gaseous Molecules. A. O. Rankine (*Proc. Roy. Soc.*, 1921, [*A*], **98**, 360—369).—There is substantial agreement between the atomic dimensions deduced from *X*-ray crystal measurement and from the viscosity by the kinetic theory. In size and shape the atoms of the monatomic inert elements are nearly indistinguishable from the atoms, respectively, of the neighbouring diatomic elements in the periodic table. The Lewis-Langmuir theory accounts satisfactorily for the viscosity relations of oxygen, chlorine, bromine, and iodine in relation to the behaviour of the corresponding inert atoms neon, argon, krypton, and xenon. A chlorine molecule may be regarded as having the size and shape of two argon atoms in contact, that is, with the outer electron shells touching each other Gaseous bromine is similarly related to double krypton atoms and iodine to xenon. An oxygen molecule has the same size and shape as two neon atoms with their outer electron shells coincident.

The best model of the hard elastic body to which a molecule composed of two equal atoms is equivalent is a spheroid. The volume of this spheroid is equal to the sum of the volumes of the hard elastic spheres to which each participating atom is separately equivalent. The nitrogen molecule appears to be equivalent to a hard, elastic body nearly spherical in shape. The atomic diameters recalculated from viscosity measurements are: neon, 2·35; argon, 2·87; krypton, 3·19; xenon, 3·51; nitrogen, 3·13, all in cm. $\times 10^{-8}$. The effective mean areas are calculated as: oxygen, 0·69; chlorine, 1·07; bromine, 1·28; iodine, 1·56, all in cm.$^2 \times 10^{-15}$. J. R. P.

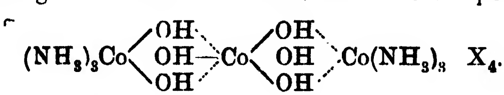
The Similarity between Carbon Dioxide and Nitrous Oxide. A. O. Rankine (*Proc. Roy. Soc.*, 1921, [*A*], **98**, 369—374).—The molecules of carbon dioxide and nitrous oxide behave not merely as though they had the same size and shape, but also as if each had an external electron arrangement practically the same as that of three neon atoms in line and contiguous. A hypothetical molecule composed of three neon atoms with their centres in line and $1·30 \times 10^{-8}$ cm. apart would correspond, on the kinetic theory of viscosity, with a mean target area of $0·895 \times 10^{-15}$ cm.^{2} The viscosity data lead to the values $0·870 \times 10^{-15}$ cm.^{2} for carbon

dioxide and $0·867 \times 10^{-15}$ cm.^{2} for nitrous oxide. Within the limits of experimental error the molecules of the two gases behave in the gaseous state as though they were of identical size and shape. This result is in agreement with Langmuir's theory (A., 1919, ii, 328).
J. R. P.

Structure of Some Compounds. GERHARD KIRSCH (*Zeitsch. physikal. Chem.*, 1920, **96**, 471—473).—On the basis of Kossel's hypothesis (A., 1916, ii, 243), that the stability of the nitrogen molecule is due to an additional nucleus, and that the similarity of the CN group to the halogens is due to this cause, the author considers other molecules, such as carbon monoxide, ozone, nitrogen dioxide, nitrous oxide, and the –CNO radicle. He considers that similar stabilising nucleii are present in these, and explains the endothermic character of these substances on this basis. J. F. S.

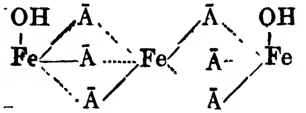
The Geometry of the Co-ordination Number. GUSTAV F. HÜTTIG (*Zeitsch. anorg. Chem.*, 1920, **114**, 24—26).—As a contribution to the problem of isomerism in co-ordinated compounds, the author has calculated the limiting radius of each of n spheres surrounding and in contact with a central sphere of unit radius, for the cases where n is 3, 4, 5, 6, 8, 12, or 20. When $n=5$ the limiting radius is the same as when $n=6$, namely, 2·414, but the disposition of the spheres in the former case is indeterminate. When n is 8, there are two possibilities; if the spheres are situated at the corners of a cube, $r=1·366$, but if at the corners of an archimedian antiprism, $r=1·549$. For higher values of n the number of possible solutions of the problem becomes greater, and a new kind of isomerism becomes a possibility in such cases. E. H. R.

The Space Significance of the Co-ordination Number in Polynuclear Compounds. HANS REIHLEN (*Zeitsch. anorg. Chem.*, 1920, **114**, 65—89).—A theoretical paper, in which the spatial arrangements in co-ordinated compounds containing several nuclei are discussed, and also the relationship between the co-ordination number and the possible spatial arrangements. In tri-nuclear compounds, if each nucleus preserves the octahedral form, the minimum co-ordination number is 12. In such compounds it must be supposed that two outer octahedra are each combined with the middle octahedron in such a way that the last shares one of a pair of parallel faces with each outer octahedron. Six groups then form "bridge linkings" between octahedra, as in the compound:



Many tri-nuclear compounds are known, however, with the co-ordination number 8, prominent among these being the red ferri-salts of organic acids of the general formula $[Fe_3\bar{A}_6(OH)_2]X$, where $\bar{A}$ is a fatty acid group. In such cases the author proposes to repre-

sent the middle nucleus of the chain by an octahedron and each of the two end nuclei by a tetrahedron, the combined geometrical form being an elongated rhombohedron. In other words, the central nucleus has a co-ordination number 6 and each of the end nuclei 4, as represented by the formula:


X.

The mixed chromi-ferri-compounds, such as

$$[CrFe_2(OAc)_6(OH)_2]Cl,6H_2O,$$

are of interest because they should show isomerism, in which the difference is caused by the substitution of iron for chromium in the central nucleus. Such isomerism has not been observed, however, probably because chromium has much less tendency than iron to form nuclei of the tetrahedral type. The author's theory is also supported by the properties and composition of the complex ferribenzoates. Many of the compounds prepared by Weinland and his collaborators are discussed from the author's point of view, and in some cases modified formulæ are suggested.

Compounds with the co-ordination number 10, for example, $[Cr_3(OAc)_6SCN,H_2O(OH)_2]$, can be represented spatially by means of a chain of two octahedra and a tetrahedron. A number of trichromiacetate compounds appear to have the co-ordination number 11, for example, the pyridine compound

$$[Cr_3(OAc)_6(C_5H_5N)_3(OH)_2]I.$$

The constitution of these substances can be explained geometrically by supposing three octahedra to be joined so as to have one edge common to all three. Between the two outer octahedra there is then an acute angle of about 33°, and by a slight distortion the faces of the two octahedra thus separated can be brought into contact so that the three octahedra form a solid figure having eleven points. Geometrically, these eleven points fall into three groups of six, three, and two points respectively, corresponding with the chemical character of the compounds of this class.

Complex co-ordinated compounds containing four nuclei are discussed from a similar point of view, and geometrical structures of the same type are suggested for them. The nature of the "bridge linking" combining the several nuclei in the molecule is also discussed. E. H. R.

Use of Gold–Palladium Alloy for Crucibles. H. S. Washington (*J. Washington Acad. Sci.*, 1921, **11**, 9—13).—For fusions of silicates with sodium carbonate, crucibles of palau, an alloy consisting of gold 80% and palladium 20%, have been employed. Apart from its lower cost as compared with platinum and iridium–platinum, this alloy has the advantage that, after fusions, the fused mass may be easily and completely removed by treatment with hot water, the superior hardness and high polish

of palau facilitating this. As regards durability, it was found that the average loss with palau crucibles, after forty-seven fusions, was 0·2 mg., whilst with iridium–platinum, after twenty-one fusions, the amount was 0·4 mg.; in the latter case, volatilisation of iridium would account for part of the loss. No comparative figures for platinum were obtained. W. J. W.

Apparatus for Simultaneous Pressure and Volume Measurements of Gases. GUSTAV F. HÜTTIG (*Zeitsch. anorg. Chem.*, 1920, **114**, 161—173).—An apparatus is described in which the pressure and volume of a gas liberated in any reaction may be determined at any moment. Gas may be added to or withdrawn from the system at any time, and the composition of the residue determined. The apparatus consists essentially of a detachable tube for the solid, connected through a detachable stopcock with a bulb communicating with a manometer. The volume of each part of the apparatus is known. The whole apparatus is exhausted, and gas admitted to the bulb and upper part of the stopcock. The manometer is read, and the initial volume of gas calculated. The stopcock is then opened, and from the manometer readings the pressure and volume of the gas are readily calculated. By means of the apparatus, the existence of $FeCl_3,12NH_3$ (9 mm. at $-79°$); of $AgBr,3NH_3$, and of $Ca,6NH_3$ could be demonstrated. In the last case, a secondary reaction, $Ca,6NH_3 = Ca(NH_2)_2 + 4NH_3 + H_2$ occurs, as well as a slow absorption of hydrogen in the solid phase. J. R. P.

Martin Heinrich Klaproth. RICHARD MEYER (*Zeitsch. angew. Chem.*, 1921, **34**, 1—3).—A biography of this German chemist, born 1743, died 1817. Klaproth's work dealt mainly with inorganic and mineralogical chemistry; he investigated the composition of sulphur trioxide, zirconite, cerite, and other rarer minerals, and detected the presence of nickel in meteorites. W. P. S.

Inorganic Chemistry.

Chloroform Solutions of Hydrogen Chloride. E. J. WILLIAMS (*Chem. News*, 1921, **122**, 62).—Hydrogen chloride can be absorbed by chloroform to a concentration of about 10 grams per litre. The equilibrium between solvent and solute is unstable, and unless the solution is kept in a closed vessel the gas passes completely out of solution. J. R. P.

Solubility of Sulphur in Alkali Hydroxides in the Cold. G. CALCAGNI (*Gazzetta*, 1920, **50**, ii, 331—340).—The author has

investigated the action on sulphur in the cold of the following solutions: 66% sodium (or potassium) hydroxide solution, ammonia solution (D 0·888), and solutions, saturated in the cold, of calcium, barium, and magnesium hydroxides, the last containing the solid oxide; as the sulphur dissolved, a fresh quantity was added until a condition of equilibrium was reached. The action of light produced no sensible effect on the velocity of dissolution of the sulphur. Analysis of the final solutions obtained gave the following results.

Sodium hydroxide: 100 c.c. contained 24·55 grams of sulphur, 57 parts of the latter being dissolved per 23 parts of sodium present. Potassium hydroxide: 100 c.c. contained 17·70 grams of sulphur, 59·35 parts of the latter being dissolved per 39·15 parts of potassium. Ammonia: 100 c.c. contained 1·367 grams of sulphur. Calcium hydroxide: 100 c.c. contained 0·1116 gram of sulphur; 32·3 parts of sulphur are dissolved per 40 parts of calcium, this amount corresponding with the formation of calcium sulphide. Barium hydroxide: 100 c.c. dissolves 2·60 grams of sulphur. When the sulphur attains a certain concentration, acicular crystals of barium tetrasulphide, BaS_4, are deposited. Magnesium hydroxide: 100 c.c. dissolves 0·014 gram of sulphur, the relation between the magnesium and sulphur present in the solution being 24·38 : 63·38, which corresponds with MgS_2.

All the solutions respond to the reaction for sulphides, polysulphides, thiosulphates, and sulphites. The conclusion is drawn that the reactions between sulphur and alkali hydroxides are highly complicated and gradual, the dissolved sulphur first forming sulphides, from which thiosulphates and, by further dissolution of sulphur, polysulphides are formed; the thiosulphates, losing part of their sulphur, yield sulphites. In the solutions more concentrated in sulphur, part of the latter appears to exist merely dissolved and uncombined, since these solutions yield sulphur to hot benzene.

All the solutions are decomposed by carbon dioxide, with separation of sulphur and liberation of hydrogen sulphide. Thus carbon dioxide acts similarly to mineral acids, but more slowly.

T. H. P.

Preparation of Sulphur Dioxide. VEREIN CHEMISCHER FABRIKEN MANNHEIM (Brit. Pat. 149662; from *Chem. Zentr.*, 1921, ii, 19).—Gaseous sulphur dioxide is obtained by heating the sulphates of the alkaline earth metals, magnesium, or iron in the presence of iron or other suitable metals or their lower oxides, or of carbon, at a comparatively low temperature. The reduction is first effected at 600°, whilst the evolution of sulphur di- and trioxides takes place at 900° in a current of steam and air.

H. W.

Preparation of Sulphuric Acid. T. SCHMIEDEL and H. KLENCKE (Brit. Pat. 149648; from *Chem. Zentr.*, 1921, ii, 19).—Gases containing sulphur dioxide are brought into intimate contact with as large a quantity as possible of nitrosylsulphuric acid

(54—58° Bé.); any gas remaining unabsorbed, and the nitrous vapours evolved from the sulphuric acid, are treated with acid of the same concentration as that in the mixing vessel. H. W.

Point Discharge in Nitrogen. M. PIRANI [with E. LAX] (*Wiss. Veröffentl. Siemens-Konzern*, 1920, **1**, 167—178; from *Chem. Zentr.*, 1921, i, 200—202).—The investigations were undertaken with the object of elucidating a method for the detection and, if possible, estimation of minute traces of impurity, particularly of aqueous vapour, in nitrogen and the rare gases. They are based on the observations of Franck and Hertz (A., 1916, ii, 461), according to which an electron formed in the neighbourhood of a point cathode in a pure gas can lead to a strong ionisation, and consequent variation in the current, which, however, is irregular in occurrence, owing to the infrequency of the phenomenon. On the other hand, the presence of minute amounts of electronegative substances, such as oxygen, oxides of nitrogen, or water, causes an increase in the current, owing to the production of electrons at the cathode. Such a gaseous mixture, however, does not behave in a stable manner, the phenomena being complicated by the occurrence of slow chemical changes, which cause gradual alterations in the strength of the current, in accordance with the nature of the chemical processes. With a pure gas, the current rises initially, owing to the liberation of inherent impurities by the heat, but falls when the maximum of impurity has been passed. In an impure gas, on the other hand, more strongly electronegative products (such as nitric oxide) may be readily formed, thus causing a decrease in the current, which subsequently rises after partial or complete absorption of the impurities by the electrodes.

The apparatus, which is operated in duplicate, consists of a 2-litre globe furnished with an aluminium plate and a molybdenum point as electrodes, the current being provided by an alternating current high-tension transformer. In spite of somewhat considerable individual variations, the same characteristics are exhibited by both sets of apparatus. The electrodes need to be replaced frequently, as they are attacked by the impurities (oxygen and aqueous vapour). The pressure of the nitrogen is 700 mm. The sources of error are fully discussed, and it is shown that the differences due to heating effects are invariably smaller than those due to impurities. The pure nitrogen is obtained from the compressed gas by absorption of oxygen and subsequent desiccation, the last traces of oxygen and aqueous vapour being removed by passage over finely divided tantalum (which has been completely freed from gases) at 1000°. Such nitrogen, with a constant alternating tension of 4320 volts, gave a current–time curve which rises to a maximum in the first three minutes, and sinks more or less pronouncedly subsequently. 10^{-4} Ampere may be regarded as mean value for the current in pure nitrogen. With this current, a dark space of a few tenths of a millimetre surrouunds the point enclosed by a violet band, from which pass brush discharges; if

oxygen is now admitted, the discharge shrinks progressively until it can only be observed with a lens. With increasing oxygen content, the minimum current becomes progressively smaller, and the rise in the time–current curve occurs after a longer period.

The maximum current strength depends in some way on the oxygen content. The time–current curves for mixtures containing oxygen, in contrast to those for pure nitrogen, exhibit a steep rise after a time. Obviously, the oxygen is gradually consumed, possibly by formation of nitric oxide, which is removed by the molybdenum or other oxidisable part of the apparatus; such removal is not, however, quantitative, and minute traces of oxygen remain, which raise the current strength above the normal value. The mixture in which the greatest rise was observed contained about $5 \cdot 10^{-4}\%$. Since measurements with similar vessels agree to within $\pm 10\%$, the oxygen content can be measured (up to $5 \cdot 10^{-5}\%$) after calibration of the apparatus with mixtures of known composition. In a similar, but less simple, manner, the content of aqueous vapour can be estimated. The appearance of the point discharge is more considerably modified by water vapour than by oxygen. The time–current curves, in contrast to those of mixtures containing oxygen, exhibit a definite and less defined minimum, which gradually disappears with increasing water-vapour content, and, in particular, shows a gradually rising branch, the current values for which with mixtures poor in aqueous vapour lie above those for pure nitrogen, and appear to lead asymptotically to a final value. The processes on which these curves depend are obviously very complicated, owing to the dissociation of water vapour. With slight modifications, the experiments can be extended to the rare gases; the sensitiveness is greater in these cases, but the phenomena are generally similar. The presence of hydrogen in nitrogen to the extent of 0·1% or more can be detected with certainty by means of the time–current curves, but the slight elasticity of the hydrogen molecules renders the method less sensitive. Apart from its analytical application, the method appears suitable for the investigation of the affinity of various substances at different temperatures for aqueous vapour, the dependence of the activity of reducing substances on temperature and state of division, and the after-glow of active nitrogen.

H. W.

Chemical Affinity of the Inactive Gases. Franz Skaupy (*Zeitsch. Physik*, 1920, **3**, 408—411).—The indifference of the inactive gases is explained by the assumption that in all cases where an opportunity is presented for the formation of an inactive gas compound, there is at the same time an opportunity for the other constituents in the mixture to react and form much more stable molecules.

J. F. S.

Solubility of Graphite in Molten Iron. Rudolf Ruer and Julius Biren (*Zeitsch. anorg. Chem.*, 1920, **113**, 98—112).—The

solubility of graphite in Swedish iron has been determined by heating the iron with graphite until saturated, and then pouring the molten metal into a metal tube so that it was cooled too rapidly for the dissolved graphite to separate. The metal was then dissolved in nitric acid (D 1·18) and the graphite determined in the usual way. Estimations were made at temperatures from 1152° to 2500°. Above 2500° approximate determinations show that the solubility continues to increase up to 2700°. The solubility curve of graphite in molten iron is linear from 1152° to 1700°, when it bends slightly at first and with increasing temperature more markedly away from the concentration axis. Examination of sections of the chilled metal showed graphite, cementite, and austenite, but no further crystalline substance. The concentration of the graphite eutectic which lies at 1152° is 4·25% carbon, that of the cementite eutectic which lies at 1145° is 4·30% carbon. The thick liquid which is formed when graphite and molten iron are in contact, with rising temperature, is due to the dissolved carbon, and the only action of the increased temperature is that it increases the solubility of the carbon in iron. J. F. S.

Properties of Potassium Arseno-thiosulphate: Structural Formula of Trithionic Acid. JULIUS VON SZILÁGYI (*Zeitsch. anorg. Chem.*, 1920, **113**, 75—84).—Potassium arseno-thiosulphate is prepared by adding a solution of 37·24 grams of crystallised sodium thiosulphate in 60 c.c. of water to a solution of 4·95 grams of arsenious oxide in 35 c.c. of hydrochloric acid (D 1·06) and 11·18 grams of potassium chloride in 30 c.c. of water at 3°. Three volumes of 96% alcohol are added to the mixture, when the double salt is precipitated. It is rapidly filtered and washed with alcohol and ether. It is a pure white compound, which is not very stable in the moist condition; it is amorphous, and is very soluble in water, slightly soluble in 50% alcohol, and insoluble in absolute alcohol, ether, and chloroform, D_4^{18} 2·292. When quite dry, it may be preserved, but when moist, even with chloroform or ether it becomes yellow. When the dry salt is heated, it decomposes according to the equation $2K_3As(S_2O_3)_3 = As_2S_3 + 3K_2SO_4 + 3SO_2 + 3S$; on keeping or boiling a solution of the salt it decomposes according to the equation $2K_3As(S_2O_3)_3 \rightleftharpoons As_2S_3 + 3K_2S_3O_6$. Attempts to prepare corresponding sodium and rubidium salts failed. The general relationships of the complex arsenic, bismuth, and antimony thiosulphates are considered (see Hauser, A., 1903, ii, 487), and it is shown that the existence and properties are influenced by the character of the tervalent element. In any given series of compounds the solubility increases in the order potassium, rubidium, cæsium, barium, sodium. The author deduces the structural formula of trithionic acid from the decomposition of potassium arseno-thiosulphate, which can only take place thus:

$$(KO\cdot SO_2\cdot S)_3As \quad As(S\cdot SO_2\cdot OK)_3 = As_2S_3 + 3KO\cdot SO_2\cdot S\cdot SO_2\cdot OK,$$

which gives trithionic acid the persulphide formula. J. F. S.

Figures Produced by Crystallisation of Potassium Dichromate. MASAMICHI KIMURA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 173—178).—When a solution of potassium dichromate is allowed to evaporate on a glass plate, crystallisation first starts at the boundaries of the solution, the crystals being built up inwards, but at a certain stage, the solution having become supersaturated, a different form of crystal growth suddenly starts in the central portion and proceeds with great rapidity. The crystalline deposit thus formed has the appearance of much-branched seaweed. By allowing the solution to evaporate on a gelatin film the rate of growth of this crystalline form was much reduced and its observation was facilitated. The phenomenon may be explained by supposing that, before crystallisation, the molecules of the solute, in virtue of their electric fields, combine to form molecular aggregates of increasing complexity as the solution becomes supersaturated. The paths traced out by the rapidly growing tree-like crystals may be taken as an indication of the distribution of these aggregates just before the solution begins to crystallise. E. H. R.

Investigation by means of *X*-rays of the Crystal Structure of Sodium Chlorate and Sodium Bromate. N. H. KOLKMEIJER, J. M. BIJVOET, and A. KARSSEN (*Proc. K. Akad. Wetensch. Amsterdam*, 1920, **23**, 644—653).—*X*-ray photographs were taken by the method described in a previous paper (A., 1919, ii, 108), using the finely powdered, crystalline substance. The length of the edge of the elementary cube cell, which contains four molecules, is $6{\cdot}55 . 10^{-8}$ for sodium chlorate and $6{\cdot}74 . 10^{-8}$ for the bromate. The unit cell being divided into eight small cubes, four of these cubes, chosen tetrahedrally, each contain one molecule, and the sodium and halogen atoms are situated on non-intersecting diagonals of the four cubes. The three oxygen atoms are grouped round a halogen atom. The distance between an oxygen atom and a neighbouring halogen atom is approximately one-seventh of the parameter of the lattice. E. H. R.

Investigations on the Salt Character of Lithium Hydride. KURT MOERS (*Zeitsch. anorg. Chem.*, 1920, **113**, 179—228).—Experimental details are given for the preparation of lithium hydride from lithium and hydrogen. To decide whether lithium hydride has the characteristics of a salt or no, the action of mercury on lithium hydride has been studied, and it is shown that the action is a decomposition, and not a solution, which points to the fact that lithium hydride is a salt. Investigation of the appearance, crystal form, density, heat changes, and specific heat and the determination of the various constants, and comparison of these with the corresponding constants for the alkali haloïds all point to the salt character of the hydride. The following constants have been determined: density, 0·816; molecular volume, 9·77; heat of formation, 21,600±250 cal.; $Li + H_2O = LiOH + \frac{1}{2}H_2 + 52723 \pm 200$ cal.; $LiH + H_2O = LiOH + H_2 + 31110 \pm 50$ cal. The electrical conduc-

tivity has been determined with both direct and alternating current. The direct current experiments show a very large increase in conductivity with increase in temperature, but on account of polarisation which occasioned subsidiary changes a temperature–conductivity curve could not be constructed. With alternating current it is shown that the conductivity increases with increasing temperature until it reaches values of the same order as that of sulphuric acid of maximum conductivity. The temperature-coefficient of the conductivity shows a maximum at 550°. Galvanic polarisation could be detected, and its changes followed and measured. With direct current the products of the electrolysis could be isolated. The presence of hydrogen was proved by the increase in pressure during electrolysis in a vacuum, and metallic lithium was found on the cathode. From these facts and others it is practically certain that in the electrolysis of lithium hydride, hydrogen is liberated at the anode, and this represents the first instance in which hydrogen appears as a negatively charged ion. It is therefore shown that lithium hydride is to be regarded as a salt in which lithium constitutes the kation and hydrogen the anion, and hydrogen is to be regarded as an extremely weak acid. J. F. S.

Halogen Silver Ammoniates. WILHELM BILTZ and WILHELM STOLLENWERK (*Zeitsch. anorg. Chem.*, 1920, **114**, 174—202).—XI. (see *Zeitsch. anorg. Chem.*, 1919, **109**, 132). The apparatus of Hüttig (see this vol., ii, 195) was used. Freshly precipitated silver haloids are necessary, since these lose their activity on keeping. The existence of $AgCl,3NH_3$ and $2AgCl,3NH_3$ was confirmed, and a new compound, $AgCl,NH_3$, with dissociation pressures previously given for $2AgCl,3NH_3$ was obtained. The sesqui- and mono-ammoniates form mixed crystals above 30°. The existence of the compounds $AgBr,3NH_3$, $2AgBr,3NH_3$, and $AgBr,NH_3$ was confirmed, as well as that of the compounds $AgI,3NH_3$, $2AgI,3NH_3$, AgI,NH_3, and $2AgI,NH_3$. All the iodides form mixed crystals. The heats of formation were calculated from Nernst's formula $\log p = -Q_0/4{\cdot}57T + 1{\cdot}75 \log T + aT + 3{\cdot}3$ as follows (values of Q_0): $AgCl,3NH_3$, 9·16 Cal.; $AgCl,1\frac{1}{2}NH_3$, 10·52 Cal.; $AgCl,NH_3$, 11·11 Cal.; $AgBr,3NH_3$, 8·64 Cal.; $AgBr,1\frac{1}{2}NH_3$, 9·95 Cal.; $AgBr,NH_3$, 10·65 Cal.; $AgI,3NH_3$, 6·92 Cal.; $AgI,1\frac{1}{2}NH_3$, 7·25 Cal.; AgI,NH_3, 8·56 Cal.; $AgI,2NH_3$, 7·05 Cal.; $AgI,\frac{1}{2}NH_3$, 11·59 Cal.

The values of the constant a in the equation were found to be:

	$3NH_3$.	$2NH_3$.	$1\frac{1}{2}NH_3$.	NH_3.	$\frac{1}{2}NH_3$.
AgCl ...	−0·0025	—	−0·0015	−0·0015	—
AgBr ...	−0·0028	—	−0·0020	−0·0015	—
AgI ...	−0·0050	−0·0050	−0·0050	−0·0030	−0·0010

Conclusions on the affinities are drawn from the temperatures at which the dissociation pressures reach 100 mm. in all cases; these are in the order AgI, AgBr, AgCl. J. R. P.

Compounds of Ammonia with Metallic Calcium, Strontium, and Barium. WILHELM BILTZ and GUSTAV F. HÜTTIG (*Zeitsch. anorg. Chem.*, 1920, **114**, 241—265).—A descrip-

tion of the method of preparation of strontium and barium by the method of Guntz (A., 1906, ii, 669) is given. All the alkaline-earth metals form hexammines, $M(NH_3)_6$. The values of Q_0 (see preceding abstract) were found from the tension curves to be: $Ca(NH_3)_6$, 10·32 Cal.; $Sr(NH_3)_6$, 9·91 Cal.; $Ba(NH_3)_6$, 9·65 Cal. The reaction $M(NH_3)_6 = M(NH_2)_2 + 4NH_3 + H_2$ occurs rapidly with barium, slowly with calcium. The identical behaviour of the metal atom and ion is pointed out. This may indicate that the presence of the two valency electrons in the atom has no influence on the absorption, or that the metal is composed of ions and free electrons.

J. R. P.

Basic Exchange in Silicates. III. E. RAMANN and H. JUNK (*Zeitsch. anorg. Chem.*, 1920, **114**, 90—104).—In continuation of previous work (A., 1917, ii, 468; 1919, ii, 154), the formation of magnesium permutite by the action of magnesium salts on ammonium, sodium, and potassium permutites has been studied. As in other cases, the reaction is ionic, and there is no evidence of physical adsorption. Pure magnesium permutite could not be obtained, not more than half of the bases present in the original permutite being displaced by magnesium. The whole of the ammonium in ammonium permutite could not be displaced by treatment with carnallite or kainite solutions. Mixed salt solutions decompose the permutite to some extent, especially solutions containing magnesium or ammonium. This observation may have some bearing on the decomposition of natural silicates, which cannot always be adequately accounted for by the action of water and carbonic acid.

E. H. R.

Liberation of Gas from Cold-worked Metals during Recrystallisation. G. TAMMANN (*Zeitsch. anorg. Chem*, 1920, **114**, 278—280).—On heating a drawn copper wire in a vacuum, gas was evolved, the rate of evolution being greatest between 200° and 300°. At this temperature, the alteration of structure of the cold-drawn wire is also most rapid. The evolved gas gave the spectra of carbon monoxide and dioxide. Electrolytic iron showed in the first heating a maximum rate of evolution of gas at 530—600°; in the second heating at 610—650°. The spectrum of the gas showed the lines of hydrogen and carbon monoxide. A sublimate of lead was obtained from the iron. This is observed only when the metal has been cold-worked before heating in a vacuum.

J. R. P.

The Relative Firmness of the Combination of Sulphurous Acid with Ammonia and Mercury. OTTO RUFF and ERICH KRÖHNERT [with HANS JULIUS BRAUN] (*Zeitsch. anorg. Chem.*, 1920, **114**, 203—208).—The precipitate obtained from mercuric chloride and excess of ammonia dissolves when sulphur dioxide is passed through the liquid, and crystalline compounds of mercuric oxide with ammonia and sulphur dioxide are obtained on evaporation under reduced pressure. If sulphur dioxide is first added

and then ammonia, an insoluble compound containing sulphur dioxide and ammonia is slowly deposited. The reactions were found to be: (*a*) $HgCl_2 + 2H\cdot SO_3H + 4NH_3 = Hg''(SO_3\cdot NH_4)_2 + 2NH_4Cl$, (*b*) $NH_2Hg''Cl + H\cdot SO_3H = Hg''Cl(SO_3\cdot NH_4)$, in acid solutions. With excess of ammonia, a mixture of $Hg''(SO_3NH_4)\cdot OH$, a white, insoluble powder, and $Hg''SO_3,NH_3$ or $Hg{<}{}^{SO_2-}_{NH_3}{>}O$, white needles, is precipitated:

$$Hg''(SO_3NH_4)_2 + NH_3 = Hg''SO_3,NH_3 + (NH_4)_2SO_3.$$

In presence of large amounts of ammonium chloride, one of the sulphonic groups is eliminated:

$$Hg''(SO_3NH_4)_2 + NH_4Cl + NH_3 = NH_3Cl\cdot Hg\cdot SO_3NH_4 + (NH_4)_2SO_3.$$

The compound, $NH_3Cl\cdot Hg\cdot SO_3NH_4$, forms long, white, transparent needles. $2N$-Potassium hydroxide converted this into yellow Hg_2O,SO_3,NH_3 or $O{<}{}^{Hg-SO_2}_{Hg\cdot NH_3}{>}O$. Concentrated ammonium hydroxide forms a solution, which appears to contain $Hg(NH_3)_4SO_3$; liquid ammonia forms $Hg(NH_3)_4SO_3$, as a white powder and ammonium sulphite.

In acid solution the sulphur, which receives a negative charge from oxygen, and in alkaline the nitrogen, which receives a negative charge from hydrogen, possess a strong tendency to complex formation, and in ammoniacal solution, complexes corresponding to mercurammonium sulphites are formed. J. R. P.

Compound Formation and the Electromotive Behaviour of Cerium in its Alloys with Iron and Zinc. FRITZ CLOTOFSKI (*Zeitsch. anorg. Chem.*, 1920, **114**, 1—23).—The author has applied Dolezalek's theory of binary mixtures (A., 1913, ii, 482) to the study of the binary alloys of cerium with zinc and iron respectively, and with its help has been able to demonstrate the presence of compounds in these alloys. For the preparation of the alloys, pure cerium was not available, but a metal was used containing cerium metals 97·0% (Ce 92·5%), iron 1·46%, silicon 0·88%, carbon 0·35%. Cerium–iron alloys containing from 3·9% to 84·1% of cerium, and cerium–zinc alloys containing from 26·6% to 92·7% of cerium, were prepared, and the potential difference between the alloy and pure cerium was determined in each case. It is shown on theoretical grounds that the concentration–potential difference curve in the case of a simple binary alloy, without compounds, has a logarithmic form, but if a compound is present in the alloy, a rapid increase of potential should take place at the concentration corresponding with the composition of the compound. When more than one compound is formed, the curve takes a horizontal course after the rise corresponding with the first compound, to rise again for the second compound. The curve for the iron–cerium alloys indicates the existence of a compound, CeFe, and also of a second compound, $CeFe_6$, but the composition of the latter is to some extent uncertain. The cerium–

zinc alloys show the presence of two compounds, Ce_4Zn and Ce_2Zn. The velocity constants of formation of the compounds were also calculated with the help of the theory. The constant for CeFe is given as $K=10^{10}$, whilst for the cerium–zinc alloys the constants are of the order $K_{Ce_4Zn}=4\cdot10^{77}$ and $K_{Ce_2Zn}=10^{57}$. E. H. R.

Oxidising Action of Ceric Sulphate. A. BENRATH and K. RULAND (*Zeitsch. anorg. Chem.*, 1920, **114**, 267—277).—In the oxidation of tartaric acid by ceric sulphate in presence of sulphuric acid, small quantities of didymium sulphate are without influence on the velocity. Formic acid is produced, $C_4H_6O_6 + 8Ce(SO_4)_2 + 2H_2O = 3CO_2 + HCO_2H + 4Ce_2(SO_4)_3 + 4H_2SO_4$. Addition of sulphuric acid strongly retards the reaction. Oxalic acid is oxidised to carbon dioxide,

$$C_2H_2O_4 + Ce(SO_4)_2 = 2CO_2 + Ce_2(SO_4)_3 + H_2SO_4.$$

Sulphuric acid and normal sulphates retard this reaction. Complex formation was not observed. The oxidation of anthracene is strongly accelerated by addition of sulphuric acid. The oxidation of hydrazine occurs according to the equation $2N_2H_4 + 2Ce(SO_4)_2 = N_2 + (NH_4)_2SO_4 + Ce_2(SO_4)_3$. Hydroxylamine gave nitrogen and nitrous oxide (69—73%). Sodium thiosulphate was converted into tetrathionate, $2Na_2S_2O_3 + 2Ce(SO_4)_2 = Ce_2(SO_4)_3 + Na_2SO_4 + Na_2S_4O_6$. Sulphurous acid forms equivalent amounts of sulphuric and dithionic acids; hypophosphorous acid is oxidised to phosphorous acid. Photo-oxidation of formic acid, methyl alcohol, and acetic acid is retarded by sulphuric acid.

J. R. P.

The Purification and Testing of Aluminium. FRANZ MYLIUS and WERNER MYLIUS (*Zeitsch. anorg. Chem.*, 1920, **114**, 27—64).—Experiments were made on the further purification of technical "pure" aluminium, which may contain Al 99·58%, Fe 0·18%, Si 0·22%, C 0·02%. When such a metal crystallises slowly, practically pure aluminium first crystallises, the impurities crystallising last in the eutectic. Such aluminium can be granulated by stirring the metal during crystallisation, and by extracting the granules with dilute hydrochloric acid, most of the iron can be removed. By repeating this process three times, a metal was prepared containing Al 99·9%, Fe 0·02%, Si 0·2%, C 0·01%, the loss being 50%. Purification can also be effected by partly melting the metal and separating the less pure liquid portion from the purer aluminium crystals, but the process is tedious and the yield of pure metal is low.

Experiments were made with the object of devising a test for determining the probable behaviour of technical aluminium when exposed to atmospheric influences. It was shown that aluminium of the highest obtainable purity is but slightly attacked by 20% hydrochloric acid and by other corrosive agents.

[See, further, *J. Soc. Chem. Ind.*, 1921, 150A.] E. H. R.

System and Constitution of Derivatives of Molybdic Acid. L. FORSÉN (*Compt. rend.*, 1921, **172**, 215—217).—The author considers that all the known molybdates may be derived from two acids, molybdic acid, $H_6Mo_3O_{12}$, and metamolybdic acid, $H_{12}Mo_2O_{12}$, and to molybdic acid he assigns the constitutional formula $O<\begin{matrix}MoO(OH)_2\cdot O\\ MoO(OH)_2\cdot O\end{matrix}>MoO(OH)_2$. To explain the formation of anhydrides, four spacial representations are admitted. A new *anhydride*, $H_4Mo_3O_{11}$, has been obtained in a crystalline form, and two potassium trimolybdates, having the composition

$$K_2Mo_3O_{10},3H_2O.$$

W. G.

Metallographic Investigation of the System Tungsten-Lead. SUEKICHI INOUYE (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 43—46). —Alloys of lead and tungsten containing up to 30% of the latter were prepared and investigated by the thermal method. At 1300°, the highest temperature used, lead dissolves a maximum of 30% of tungsten. The temperature of primary crystallisation could not be detected with less than 5% of tungsten. Tungsten crystallises first, and the eutectic appears to be practically pure lead. No evidence of the formation of a compound on the lead side could be found, and it is improbable that there could be one on the tungsten side, on account of the low boiling point of lead.

E. H. R.

Preparation of Uranium Compounds in the Pure State. ERNST WILKE-DÖRFURT (*Wiss. Veroffentl. Siemens-Konzern*, 1920, **1**, 143—146; from *Chem. Zentr.*, 1921, i, 170—171).—In connexion with an investigation of the catalytic activity of uranium compounds, an attempt was made to obtain a highly purified uranium oxide, U_3O_8, from some residues of cleveite which had been used for the extraction of helium. A solution of the nitrate which had been purified from the rare earth metals and thorium by oxalic acid, and from extraneous heavy metals by hydrogen and ammonium sulphides, yielded an oxide, which was not free from alkali. In the opinion of the author, the presence of the latter is due to co-precipitation of uranate, and not to adsorption, and can therefore be avoided by reduction of the uranium. By suitable regulation of the action of ammonium sulphide, it is found possible to precipitate uranous instead of uranyl sulphide, and this substance does not show any tendency to retain alkali; the latter, if absorbed, can be removed by double precipitation, and avoided by working with smaller quantities. The sulphide is readily converted into uranous chloride, which is transformed through the hydroxide into the nitrate; the latter is oxidised by nitric acid to uranyl nitrate, which is purified by being crystallised from water, and then converted into the oxide, U_3O_8, in which the presence of traces of alkali cannot be detected spectroscopically. The author avoids the frequently recommended crystallisation of uranyl nitrate from ether, since, on the one hand, the product so obtained is not

free from alkali, and, on the other, the explosive tendency of the ethereal solution renders it unsuitable for working with very valuable material. H. W.

The Existence of a Gaseous Hydride of Thorium. ALBERT KLAUBER and JULIUS MELL VON MELLENHEIM (*Zeitsch. anorg. Chem.*, 1920, **113**, 306—316).—An alloy of thorium and magnesium was prepared by heating thorium oxide, ThO_2, with two to two and a-half times its weight of magnesium powder for forty-five minutes to a dull red heat in a stream of hydrogen. A blackish-brown to grey product was obtained, which, when powdered in a mortar, gave a characteristic odour of thorium hydride. The gas was formed when the alloy was treated with water or dilute acids, and had a tendency to ignite spontaneously. To identify the gas, the method used by Paneth (A., 1920, ii, 758) for identifying lead and bismuth hydrides was used, the gas being passed through a heated Marsh tube, when a deposit of thorium was obtained, which was identified by a number of characteristic reactions. The thorium is at first deposited in the form of a brown ring, which, on further heating, becomes dark grey with a metallic appearance, indicating the existence of two modifications of thorium. The hydride is very unstable, and is produced in greatest amount at a temperature of 15—20°. The composition of the hydride could not be determined. The gas can be condensed with liquid air. Its radioactivity is very slight.

E. H. R.

Antimony Pentasulphide (Sulphur Auratum). F. KIRCHHOF (*Zeitsch. anorg. Chem.*, 1920, **114**, 266. See A., 1920, ii, 693).—Some varieties of commercial sulphur auratum contain less than 8% (0—2%) of sulphur readily extracted by solvents. These are probably obtained by the reaction $Na_3SbS_4 + SbCl_3 = Sb_2S_4 + 3NaCl$. J. R. P.

Metallographic Investigation of the System Antimony Sulphide-Silver Sulphide. KOSUKE KONNO (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 51—54).—The liquidus curve for the system antimony sulphide-silver sulphide shows a maximum at a point corresponding with 42% of silver sulphide, indicating the formation of the compound Sb_2S_3,Ag_2S, which is known in the form of the mineral miargyrite. The microscopic appearance of a section of this composition is quite homogeneous. Two eutectics are formed, between the compound and antimony sulphide at 462° with 22% Ag_2S, and between the compound and silver sulphide at 464° with 72% Ag_2S. No mixed crystals are formed in either case.

E. H. R.

Metallographic Investigation of the System Antimony Sulphide-Lead Sulphide. DAIDZI IITSUKA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 61—64).—The thermal investigation of the antimony sulphide-lead sulphide system shows the existence of four compounds, each of which corresponds with a known mineral. The

maximum on the liquidus curve corresponds with the compound $2PbS,Sb_2S_3$, jamesonite, the melting point of which is 672°. This compound reacts with excess of antimony sulphide at 610° to form the compound $3PbS,2Sb_2S_3$, warrenite, which exists in two modifications with a transition temperature at 510°. This compound, in turn, reacts with antimony sulphide to form PbS,Sb_2S_3, zinckenite. In reguli containing between 41% and 51% of PbS the last two compounds co-exist as separate phases. The last-named compound forms a eutectic with antimony sulphide at 428°, containing 14% PbS. The first compound, $2PbS,Sb_2S_3$, also reacts with lead sulphide at 590° to form the compound $5PbS,2Sb_2S_3$, corresponding with the mineral boulangerite. This compound exists in two modifications with a transition point at 468°, and forms a eutectic with lead sulphide at 557° containing 78% of PbS. E. H. R.

Some Alkali Antimony Thiosulphates. JULIUS VON SZILÁGYI (*Zeitsch. anorg. Chem.*, 1920, **113**, 69—74).—The preparation and properties of stibio-thiosulphates of sodium, potassium, rubidium, barium, calcium, and strontium are described. The method of preparation consists in adding a solution of antimony trioxide in hydrochloric acid (D 1·12) to a solution of sodium thiosulphate and the chloride of the metal concerned at low temperatures, about 3°. The formation is represented by the equations: $SbCl_3 + H_2O = SbOCl + 2HCl$; $SbOCl + 2HCl + 3Na_2S_2O_3 = 3NaCl + H_2O + Na_3Sb(S_2O_3)_3$. The salts in all cases, except those of sodium, calcium, and strontium, may be crystallised at low temperatures and are precipitated by the addition of 96% alcohol. *Sodium stibio-thiosulphate*, $Na_3Sb(S_2O_3)_3$, is extremely soluble, and has not been obtained in the solid condition; all attempts to obtain the solid salt brought about decomposition according to the equation

$$2Na_3Sb(S_2O_3)_3 = 3Na_2S_2O_3 + Sb_2OS_2 + 4SO_2.$$

Potassium stibio-thiosulphate, $K_3Sb(S_2O_3)_3$, forms silk-like, needle-shaped crystals very similar in appearance to asbestos. It is very soluble in water, and on diluting the solution a very slight turbidity is produced which points to the presence of the complex ion, $Sb(S_2O_3)_3'''$. On boiling a solution decomposition occurs, forming the orange-red compound, Sb_2OS_2, as in the case of the sodium compound. On heating the crystals above 100° the decomposition $2K_3Sb(S_2O_3)_3 = Sb_2S_3 + 3K_2SO_4 + 3SO_2 + 3S$ takes place. This compound is shown to have the constitution $Sb(S\cdot SO_2\cdot OK)_3$. The rubidium salt is similar in all respects to the potassium salt. *Barium stibio-thiosulphate*, $Ba_3[Sb(S_2O_3)_3]_2$, is not very stable at the moment of precipitation; it is white, but speedily becomes yellow, and finally very deep yellow in colour, due to decomposition. The strontium and calcium salts exist for only a very short time in solution, and have not been isolated. J. F. S.

Metallographic Investigation of the System Bismuth–Selenium. NAOJIRO TOMOSHIGE (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 55—60).—A thermal investigation of the bismuth–selenium system

led to the following results. The compound Bi_2Se_3 is indicated by a maximum on the liquidus curve; the compound forms white prisms melting at 688°. It mixes with excess of bismuth in the liquid state, and on cooling crystallises out until the temperature reaches 602°, at which point a reaction takes place between the compound and bismuth with formation of the β-form of a new compound, BiSe, the reaction taking place with development of heat. On further cooling the compound BiSe crystallises out down to 422°, the transition point, at which it changes into the α-form. The final eutectic temperature on the bismuth side is practically the melting point of bismuth, 267°. On the selenium side of the diagram the compound Bi_2Se_3 forms a homogeneous liquid with 14% of selenium, which at 604° deposits the compound. With more than 51% of selenium two layers are formed, the above homogeneous liquid being in equilibrium with a solution of selenium containing 9% of bismuth. On cooling, Bi_2Se_3 is deposited until one liquid layer disappears; the other then deposits the compound, and finally crystallises as a eutectic at 161°. E. H. R.

Metallographic Investigation of the System Bismuth Sulphide-Antimony Sulphide. YASUYO TAKAHASHI (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 47—50).—Mixtures of bismuth and antimony sulphide were examined by the cooling method, and the liquidus and solidus curves plotted. The two sulphides form a complete series of mixed crystals At its melting point bismuth sulphide dissociates to the extent of about 1·5% into bismuth and sulphur.

E. H. R.

Chemical and Galvanic Activity Boundaries of the Copper-Nickel, Palladium-Copper, and Palladium-Silver Mixed Crystals. LEO NOWACK (*Zeitsch. anorg. Chem.*, 1920, **113**, 1—26. Compare Tammann, A., 1919, ii, 398).—Mixed crystals of nickel and copper, palladium and copper, and palladium and silver have been prepared, and the limits of the chemical activity of these crystals, which in each case cover the whole range of compositions, have been determined by a study of the rate of reaction of sodium hydroxide, alkaline hydrogen peroxide solutions, an alkaline solution of tartaric acid, ammonium persulphate, silver nitrate, silver sulphate, copper sulphate, copper nitrate, mercuric cyanide, nitrate, and chloride, respectively, with the various mixed crystals. The evolution of oxygen from the crystals when used as anode in the electrolysis of various salts has been studied, and the general electromotive behaviour of the various alloys determined. It is shown that in the case of palladium–copper alloys the activity boundary toward various chemical reagents lies at 2/8 mol. palladium; in certain cases this value is not quite reached, and in one single case it is slightly exceeded. The same boundary is found for the copper–nickel alloys, except with sodium persulphate and mercuric cyanide, where the boundary 4/8 mol. nickel is obtained. In the action of silver sulphate and mercuric nitrate on the nickel–

copper alloys the activity persisted up to 6/8 mol. nickel; this activity is, however, variable with temperature, and consequently has not the same significance as the other activity boundaries. A comparison of the results of Tammann (*loc. cit.*) for gold–copper alloys with the present results for nickel–copper alloys or palladium–copper alloys shows that the activity boundary toward solutions containing active sulphur, and weak oxidising agents, is practically the same in all three cases. The same is also true for the precipitation of palladium from a solution of palladium chloride. On the other hand, the precipitation boundary of silver from silver salts lies at $\frac{1}{8}$ mol. gold in gold–copper alloys, but at $\frac{2}{8}$ mol. palladium in palladium–copper alloys. In the precipitation of mercury by gold–copper alloys the precipitated mercury diffuses into the alloy and destroys the space-lattice, whereby copper atoms which are not on the surface become exposed to the action of the reagent. For this reason alloys which are extremely poor in copper precipitate mercury, and there is no activity boundary. Since the relationship of palladium to mercury is much less than that of gold to mercury, this complication does not occur with the palladium–copper alloys, and in this case the activity boundary lies sharply at $\frac{2}{8}$ mol. palladium. The electrometric determination of the *P.D.* of copper–nickel alloys shows that the whole of the series of alloys have the same *P.D.* as pure copper. Anodic evolution of oxygen occurs with palladium–copper alloys from 1·0 to 0·28 mol. palladium, with palladium–silver alloys from 1·0 to 0·48 mol. palladium, and with copper–nickel alloys from 1·0 to 0·48 mol. nickel. The current–potential curves show the same decomposition voltage for all alloys of the above-mentioned compositions. The voltage at which a stronger and continuous opposing current flows is the same as that with palladium for all palladium–copper and palladium–silver alloys up to $\frac{4}{8}$ mol. palladium, whilst for nickel–copper alloys up to $\frac{4}{8}$ mol. nickel it is the same as that of nickel. The hydrogen solubility in the alloys of palladium with silver and copper has been determined, and it is shown that in the palladium–silver alloys the solubility at first increases with decreasing palladium content, and then decreases, and at $\frac{1}{2}$ mol. palladium, hydrogen ceases to dissolve. The same results are found with palladium–copper alloys, except that there is no initial increase in the solubility. J. F. S.

Chemistry of the Platinum Metals. I. Existence of Bivalent Ruthenium Compounds. HEINRICH REMY (*Zeitsch. anorg. Chem.*, 1920, **113**, 229—252).—After a general discussion of the valency of the platinum metals, it is shown that only one compound, ruthenocyanic acid, is known in which the ruthenium exists in the bivalent condition. The author has examined the blue solutions of ruthenium compounds obtained by the action of reducing agents on ruthenic compounds and other derivatives of a higher state of oxidation. The method consisted in titrating solutions of ruthenic chloride with dilute sodium amalgam until the

sepia-brown colour of the solution changed to clear blue. Further additions of amalgam did not affect the colour, but there was a precipitation of metallic ruthenium. All experiments were carried out in an atmosphere of carbon dioxide. The experiments show that in the blue solution ruthenium is present for the most part in the bivalent condition, but it appears to be impossible to effect a complete conversion of all the ruthenium into the bivalent condition without at the same time reducing some of it to the metallic condition. There are indications that a proportion of the bivalent ruthenium ions is converted into univalent ruthenium ions. The action of a number of reagents on the blue solution has been investigated: cold sodium hydroxide gives a brown coloration which, if the solutions are concentrated, becomes a brown precipitate, soluble in hydrochloric acid to form a blue solution, but if only a trace of air is admitted the solution is green; hot sodium hydroxide gives a dark brown precipitate which is soluble in 10% hydrochloric acid with the formation of a yellowish-brown solution; ammonia gives a greyish-black precipitate soluble in hydrochloric acid to a blue solution and soluble in excess of ammonia to a dark violet solution; hot ammonium carbonate gives a dark green coloration; iodine solutions are decolorised in the presence of acid. The whole of the reactions of bivalent ruthenium solutions show that in this valency stage ruthenium compounds are excessively unstable. J. F. S.

Mineralogical Chemistry.

The Formation and Chemical Structure of Coal. F. Fischer and H. Schrader (*Brennstoff-Chem.*, 1921, **2**, 37—45). —In the peatification of plant residues the cellulose is acted on by bacteria, disappearing in time, being converted into carbon dioxide and water. This results in an increase in the relative amount of lignin. This course of events can be followed in peat. The methoxyl group in the lignin is hydrolysed with the production of methyl alcohol, or is reduced to the methyl group. The methyl alcohol may have been further reduced to methane. By saponification of the acetyl group the neutral lignin is converted into a phenolic, alkali-soluble substance, humic acid. From the humic acids the humins are obtained by condensation, with the loss of water. Further loss of water, carbon dioxide, and possibly methane at normal temperatures gives coal and lignite. The benzene structure of the original lignin is retained throughout the formation. A comparison of the behaviour of lignin and cellulose with different reagents indicates that it is the former, and not the latter, which must be regarded as the mother substance of coal. W. P.

Exchange of Ions on the Surface of Minerals. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1920, **113**, 149—162).—The author has measured the potential of galena, litharge, zinc blende, graphite, magnetite, iron pyrites, manganese silicide, and orthoclase against the normal hydrogen electrode,

$$Zn \,|\, 2N\text{-}ZnSO_4 \text{ soln.}, Pb \,|\, PbCl_2(\text{sat.}) \,|\, , Cu \,|\, CuSO_4 \,|, \text{ and } Ag \,|\, Ag_2SO_4(\text{sat.}),$$

under various conditions of polarisation, and from the results has shown that minerals, such as sulphides and silicates, suspended in aqueous solutions exchange their less noble kations for the more noble hydrogen kation. This hydrogen charge then protects them from exchange with metal ions, which are less noble than the hydrogen ion. In the case of the sulphides, the exchange takes place rapidly, but with silicates extremely slowly. The present results confirm the work of Rubens (*Sitzungsber. K. Akad. Wiss. Berlin*, 1917, **1**, 47), who found that binary salt crystals reflected and absorbed certain ultra-red rays very strongly, and in order that this could occur, it is necessary that the points of crystal lattice must be occupied by ions, a demand which the present work substantiates. The present work also explains the adsorption of very small quantities of radioactive substances and the presence of small quantities of noble metals in the compounds of less noble metals. J. F. S.

Bementite and Neotocite from Washington: Identity of Caryopilite with Bementite. J. T. PARDEE, E. S. LARSEN, jun., and GEORGE STEIGER (*J. Washington Acad. Sci.*, 1921, **11**, 25—32).—Bementite occurs over a wide area in western Washington, where with other manganese minerals it forms large rock masses associated with limestones in metamorphic rocks. The fresh material is light grey or brownish-grey, and is compact and tough; H 6, D 3·106. Under the microscope, it is seen to consist of a felted aggregate of transparent fibres and plates with micaceous cleavage. It is decomposed by hot acid, and is readily fusible to a black glass. Analysis I is of material (from the Olympic Range) isolated by means of heavy liquids. This is compared with previous analyses of bementite from Franklin Furnace, New Jersey (G. A. Koenig, 1887, and A., 1910, ii, 220), and the average molecular ratio of the three analyses is $40{\cdot}7MnO,34{\cdot}8SiO_2,24{\cdot}1H_2O$, or nearly $8MnO,7SiO_2,5H_2O$. This composition is not essentially different from that of the Swedish caryopilite (A. Hamberg, 1889), and the optical characters are also in agreement

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MnO_2.
I.........	39·92	1·32	—	4·15	41·58	—
II.........	37·15	$\underbrace{\quad 2{\cdot}58 \quad}$		—	37·00	2·03

	CaO.	MgO.	H_2O-.	H_2O+.	CO_2.	Total.
I.........	0·40	4·46	0·49	7·90	—	100·22
II.........	2·86	2·82	$\underbrace{\quad 14{\cdot}07 \quad}$		2·10	100·61

Neotocite occurs as veinlets in the bementite of the Olympic

Range. It is brown to black, with resinous lustre and conchoidal fracture; brittle (H 4) and optically isotropic. Analysis II is compared with earlier analyses of this mineral; they suggest a ratio $R''O:SiO_2$ near 1:1, with variable amounts of water.

L. J. S.

Augite from Vesuvius and Etna. HENRY S. WASHINGTON and H. E. MERWIN (*Amer. J. Sci.*, 1921, [v], **1**, 20—30).—Crystals of augite from scoria and vesicular leucite-tephrite from the crater of Vesuvius gave I; the material analysed enclosed some glass, leucite, and magnetite; D 3·242, refractive index β 1·700—1·711. Loose crystals from ashes and tuffs at Monti Rossi, Etna, gave II (III after deducting 4% of magnetite); D 3·373, refractive indices of the material analysed near α 1·704, β 1·711, γ 1·732.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO
I.	47·60	1·52	6·01	3·17	4·59	0·13
II.	47·89	2·02	3·55	4·17	5·98	0·20
III.	50·09	2·11	3·71	1·47	4·96	0·21

	CaO.	MgO.	Na_2O.	K_2O.	H_2O.	Total.
I.	21·52	14·43	0·70	0·76	0·08	100·51
II.	21·49	13·40	0·70	0·01	0·21	99·62
III.	22·48	14·01	0·73	0·01	0·22	100·00

Anal. I is very close to one given by A. Lacroix (*Compt. rend.*, 1917, **165**, 211) of pyroxenite, consisting almost entirely of granular augite, from Monte Somma, Vesuvius. The reason why apparently the same material should form floating crystals as well as such a granular aggregate is discussed in connexion with theories of differentiation by gravitation and by fractional crystallisation.

Anal. II corresponds with the molecular percentages $CaMgSi_2O_6$ 70·0, $CaFeSi_2O_6$ 16·5, $CaSiO_3$ 1·5, $(Mg,Fe)Al_2SiO_6$ 7·0, $Na(Fe,Al)Si_2O_6$ 5·0. The Etna augite is compared with that from Stromboli (A., 1918, ii, 271). General remarks are made on the imperfections of mineral analyses; in the previous analyses of these augites, titanium and alkalis were not estimated.

L. J. S.

Analytical Chemistry.

A Soxhlet Apparatus for Extraction with Warm Solvents. LEO SOEP (*Chem. Weekblad*, 1921, **18**, 97).—The vapour of the solvent is made to pass through a worm coiled against the inside wall of the extractor before escaping to the condenser.

S. I. L.

The Importance of Adsorption in Analytical Chemistry. IV. The Adsorption of Alkalis by Cellulose. V. The Adsorption of Salts of the Alkali and Alkaline Earth Metals and of Alkaloids by Filter Paper. I. M. Kolthoff (*Pharm. Weekblad*, 1921, **58**, 46—56. Compare this vol., ii, 19, 123).—IV. Cotton wool or filter paper was shaken with a standard alkali solution, which, after equilibrium was reached, was titrated with acid in presence of dimethyl-yellow. No difference was observed in the alkali content of the solution poured or filtered off from the cellulose and that expressed from the cellulose. For sodium and potassium hydroxides, the quantities adsorbed by 1 gram of cellulose are directly proportional to the end concentration of the solutions up to a strength of $4N$. For sodium hydroxide solutions having end concentrations between $4N$ and $6N$, the quantity taken up is constant. When the end concentration increases above $6N$, the amount taken up increases suddenly, remaining constant at the new value until the end concentration reaches $8N$. There is thus no adsorption, in the true sense, at all.

With barium hydroxide, the amounts taken up, within the limits of solubility in water, were proportional to the square roots of the end concentrations. Sodium and potassium carbonates were not taken up at all. In presence of traces of other alkalis, the quantity of ammonia taken up from aqueous solution is constant and independent of the concentration, but if no other alkali or if acid be present, none is taken up.

V. Neither calcium nor barium salts are taken up by filter paper; with the former, slight negative adsorption was observed, and traced to the calcium content of the ash. With sodium chloride solutions, slight negative adsorption of the chlorine ion was found. With ammonium chloride, no adsorption occurs of either ion, and the same was found for the nitrates, sulphates, iodides, and chromates of the alkali metals. With the chromates in acid solution, no adsorption occurs, but, after long keeping, gradual oxidation of the paper sets in.

For the determinations with alkaloid salts, estimation with permanganate was adopted, the factor being determined for each alkaloid. With morphine hydrochloride, no adsorption occurred, but quinine hydrochloride and strychnine nitrate were both taken up in small quantities, the amounts being found to be in exact agreement with the adsorption equation $x/m = ac^{1/n}$, where x/m is the quantity adsorbed per gram of filter paper, c is the end concentration of the solution, and a and $1/n$ are constants.

S. I. L.

Apparatus for Titration with Alkali Hydroxides. A. Bessemans (*J. Pharm. Belg.*, 1920, **2**, 495; from *Chem. Zentr.*, 1920, iv, 702).—The alkali hydroxide in the burette is protected from the action of atmospheric carbon dioxide, since air can only enter the apparatus after passage through potassium hydroxide solution (10%).

H. W.

The Determination of Hydrogen-ion Concentration by the Colorimetric Method and an Apparatus for Rapid and Accurate Work. ERNEST VAN ALSTINE (*Soil Sci.*, 1920, **10**, 467—479).—An apparatus is described for use where a large number of determinations of hydrogen-ion concentration of various solutions are necessary. It is adapted for use with the double-tube standards of Gillespie (*Soil Sci.*, 1920, **9**, 115). The essential part of the new apparatus is an eyepiece, which is shown in detail in the original. W. G.

Estimation of Iodides in the Presence of Iodates. V. THÜRINGER (*Bull. Soc. Chim. România*, 1920, **2**, 73—77).—For the estimation of iodates in the presence of iodides, 0·2 gram of the substance dissolved in water is added to a solution containing 1·5 gram of potassium iodide and 5 c.c. of dilute sulphuric acid, and the iodine liberated is titrated with *N*/10-sodium thiosulphate solution. For the estimation of the iodide, a known volume of *N*/60-iodic acid, in excess of that required to decompose all the iodide, is added, the solution is acidified with sulphuric acid, and boiled until the whole of the free iodine has been driven off. It is then cooled, and the residual excess iodic acid is estimated as described above. From these two titrations, the amount of iodide present in the original mixture can be calculated. W. G.

Estimation of Hydrogen Sulphide in Natural Waters. É. CHRÉTIEN and H. VANDENBERGHE (*Ann. Chim. anal.*, 1921, [ii], **3**, 19—23).—One litre of the water, having a normal alkalinity due to carbonates, is treated with 20 c.c. of saturated barium chloride solution, and filtered out of contact with the atmosphere; 510 c.c. of the filtrate are then added to 10 c.c. of *N*/100-iodine solution and 0·1 gram of potassium iodide, 10 c.c. of *N*/100-thiosulphate solution are added, and the excess of the latter is titrated with *N*/100-iodine solution. W. P. S.

Microchemical Identification of Gaseous Ammonia as Hexamethylenetetramine Picrate. C. KOLLO and (MLLE) V. TEODOSSIU (*Bull. Soc. Chim. România*, 1920, **2**, 100—102).—The reagent used is a 40% solution of formaldehyde saturated first with picric acid and then with hexamethylenetetramine picrate. On exposing a drop of this solution on a microscope slide in an atmosphere containing a trace of ammonia, characteristic microscopic crystals of hexamethylenetetramine picrate are deposited. W. G.

Behaviour of Neutral Ammonium Citrate in certain Phosphate Solutions. H. E. PATTEN and G. H. MAINS (*J. Assoc. Off. Agric. Chem.*, 1920, **4**, 235—237).—Ammonium citrate, when added to a hydrochloric acid solution of a phosphate baking powder, prevents the precipitation of calcium phosphate on the addition of ammonia; the calcium phosphate is converted into calcium citrate, and at P_H values below 5·0 the calcium citrate is

kept in solution. At P_H values between 5·0 and 7·0 the precipitation of calcium citrate is very slow, but at 7·1 there is immediate formation of a gelatinous precipitate of calcium citrate. W. P. S.

Electric Oven for Use in Lockemann's Modification of the Marsh Apparatus for the Estimation of Arsenic. L. BIRCKENBACH (*Chem. Zeit.*, 1921, **45**, 61—62. Compare A., 1905, ii, 353).—A small oven or furnace is described for use in place of the ordinary Bunsen burner employed to heat the Marsh arsenic tube; it consists of a block of kieselguhr containing a channel for the tube and fitted with a heating spiral (nickelchrome wire) and a cover, the latter being made in two pieces. The author recommends the use of a granulated zinc–copper alloy (zinc, 500 grams; copper, 0·635 gram) in the reaction flask; this alloy yields a very steady current of hydrogen. W. P. S.

Colorimetric Estimation of Arsenic in the Urine and Blood of Persons Treated with Salvarsan. KURT SCHEFFLER (*Zeitsch. angew. Chem.*, 1921, **34**, 5—7).—The sample (for example, 100 c.c. of urine) is evaporated to one-fifth of its volume, 25 c.c. of a mixture of sulphuric and nitric acids (1 : 4) are added, the evaporation continued until a syrup is obtained, and this syrup is heated in a Kjeldahl flask with a further quantity of the acid mixture until a clear, colourless solution is obtained and all the nitric acid has been expelled. The solution is diluted with 25 c.c. of water, mixed with 75 c.c. of Bettendorf's reagent (stannous chloride dissolved in hydrochloric acid, D 1·123), the mixture boiled, and, after thirty minutes, the brown coloration due to arsenic is compared with standards containing known amounts of arsenic. The method is trustworthy for quantities of arsenic of not less than 0·04 mg. per 100 c.c. of urine. W. P. S.

The Detection of Sodium and Potassium Ions in the Presence of Magnesium Ions. Simplified Method. EUGÈNE LUDWIG and (MLLE) HÉLÈNE SPIRESCU (*Bul. Soc. Chim. România*, 1920, **2**, 78—82).—The metals of the group calcium, strontium, and barium are removed by precipitation with ammonium carbonate or oxalate, and the filtrate is evaporated to dryness and the residue ignited. One portion of the residue is examined for magnesium in the usual manner. For the detection of potassium, a drop of a solution of copper acetate and lead acetate in acetic acid is placed on a microscope slide. A drop of a solution of sodium nitrite is added and a particle of the ignited residue. The appearance of a black precipitate of cubic crystals of the compound, $K_2CuPb(NO_2)_6$, indicates the presence of potassium. For the detection of sodium a particle of the ignited residue is added to a drop of a concentrated solution of potassium carbonate on a slide and the liquid is evaporated to dryness. A drop of a solution of potassium pyroantimonate is added, and the appearance of a characteristic, crystalline precipitate of sodium pyroantimonate indicates the presence of sodium. W. G.

Application of *p*-Nitroaniline to the Standardisation of Sodium Nitrite Solutions. WILLIAM H. BELL (*Chem. Met. and Eng.*, 1920, **22**, 1173; from *Chem. Zentr.*, 1921, ii, 94).—*p*-Nitroaniline (3·4517 grams) is washed into a 600 c.c. beaker and dissolved in a warm mixture of concentrated hydrochloric acid (10 c.c.) and water (100 c.c.), the solution being cooled subsequently to about 15°. The volume of the solution should be about 350 c.c. Sodium nitrite solution (7·0 grams per litre, about $N/10$) is added drop by drop with continuous stirring. If the solution is exactly $N/10$, 25·0 c.c. of it are required. After addition of 22 or 23 c.c., the solution is tested for free nitrous acid by starch-iodide paper. The method is more rapid and convenient than that recommended by Lunge.

H. W.

The Precipitation of Zinc with Chromium. TOYOKICHI YASUI (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 65—67).—The precipitate of chromium hydroxide, from a solution of a chromium salt, formed on addition of ammonia in presence of ammonium chloride is always contaminated with zinc if this is present in solution. Quantitative experiments were made, in which the ratio of Cr_2O_3 : ZnO in solution was varied within wide limits, and it was shown that the proportion of zinc hydroxide carried down by the chromium hydroxide increased with the proportion of ZnO present in solution. With a ratio Cr_2O_3 : ZnO equal to 1 : 11, the weight of ZnO found in the precipitate was one and a-half times the amount of Cr_2O_3 actually present. Three precipitations are necessary to obtain chromium hydroxide approximately free from zinc.

E. H. R.

New Modification of the Electrolytic Estimation of Copper. F. G. HAWLEY (*Eng. and Min. J.*, 1920, **110**, 162—165; from *Chem. Zentr.*, 1920, iv, 664—665).—The results obtained in the electrolytic estimation of copper are influenced by the presence of various components of the mineral, such as arsenic, antimony, bismuth, selenium, and molybdenum, which are completely or partly precipitated with the copper. These metals seldom occur in considerable quantity in copper ores, but are frequently present in small amount and accumulate markedly in the flotation concentrates. In general, their deposition commences after the bulk of the copper has been precipitated, and advantage may be taken of this peculiarity for their analytical detection. Slight or no co-precipitation occurs with 0·2—0·3% of arsenic, but with larger amounts a few tenths or 1% of this metal remains in solution, the remainder being precipitated with the copper. The latter is coloured pale grey by smaller amounts, darker by larger quantities. The behaviour of antimony resembles that of arsenic. Molybdenum is more frequently present in copper ores than is generally assumed. In the electrolytic estimation of copper, its behaviour is similar to that of arsenic and antimony. If only present in small amount, its deposition can be prevented by the addition of a small

quantity of a chloride; thus 1 mg. of sodium chloride prevents the precipitation of 6 mg. of molybdenum without affecting the precipitation of the copper. The presence of small amounts of the metal imparts a chocolate-brown colour to copper which, with larger quantities, becomes steel-blue to black. If the above impurities are only present to the extent of 0·10—0·15%, the copper may be obtained in the pure condition by solution from the cathode and re-deposition. Bismuth is precipitated completely with copper; with small quantities, the copper has a tile-red colour and exhibits black spots and stripes, whilst with larger amounts the whole precipitate is dark. Selenium and tellurium are deposited at the beginning of the electrolysis, so that an early occurrence of a dark coloration shows the presence of these elements. In the presence of bismuth, copper cannot be purified by repeated precipitation.

A modified method for the electrolytic estimation of copper is proposed. The sample (1—3 grams) is treated with sodium hydrogen sulphate (about 1 gram), ammonium sulphate (1 gram), and sulphuric acid (70%, 5 c.c.); nitric acid saturated with potassium chlorate (5 c.c.) is added, followed after one to two minutes by a further 10 c.c. of the reagent. The mixture is left in a warm place for a time, and subsequently heated until the bulk of the nitric acid is driven off; the sulphuric acid is then evaporated, and the residue is heated until it becomes pasty. Any iron which may be present is transformed by this treatment into anhydrous ferric sulphate, which is insoluble in concentrated, slightly soluble in dilute sulphuric acid. Water (1 c.c.) is added, followed by 50 c.c. of a solution containing ammonia (2 litres), water (4 litres), and ammonium nitrate (100 grams); after thorough stirring, the mixture is heated to boiling for a few seconds, cooled slightly, treated with ammonia (5 c.c.), and filtered. The precipitate is washed once with a little water, then with a little ammonia (1 : 1), and finally with water. The greater part of the copper is present in the filtrate, the remainder being retained with the impurities by the iron precipitate. The solution is boiled until most of the ammonia is expelled, and acidified when cold with sulphuric acid (3 c.c.) and nitric acid (3 c.c.). The remainder of the copper is brought into solution by treatment of the precipitate with dilute nitric acid, and reprecipitation of the iron by ammonia in the presence of a few drops of potassium cyanide solution (2%). This, together with the hydroxide precipitate, is treated in the rapid electrolysis apparatus with 0·2 ampère for twenty-five to thirty-five minutes, when the copper is deposited quantitatively at the cathode, whilst the impurities remain in the precipitate. The small quantity of copper is brought into solution by reversing the current, the main copper solution is added, and electrolysis is effected with 1—1·5 ampères. A further quantity of iron must be added if the specimen contains less than five times as much of this metal as of impurities, but the procedure is seldom necessary. Molybdenum is not removed in this manner, and, should it be present, it is necessary to introduce a

small quantity of a soluble lead salt before addition of the ammoniacal liquid. The particular action of the individual reagents is described. Test analyses show that the method, which in spite of the many individual operations is simple and rapid, gives accurate results. H. W.

Volumetric Analysis. OTTO SASSE (*Pharm. Zeit.*, 1920, **65**, 559, 688).—Methods are described for the volumetric estimation of mercuric chloride (titration with potassium iodide solution), chloroform (decomposition with potassium hydroxide and determination of the chloride formed), and lead salts (titration with an excess of potassium dichromate solution and iodometric determination of the excess). The method given for mercuric chloride may be used for the analysis of mercuric chloride tablets after the red colouring matter has been destroyed by treatment with chlorine. W. P. S.

Decomposition of Iron Oxides. F. LETEUR (*Ann. Chim. anal.*, 1921, [ii], **3**, 16—19).—Practically all mineral iron oxides may be dissolved readily by heating them at 65° in closed vessels with concentrated hydrochloric acid, particularly if the latter is saturated with hydrogen chloride just before use. The pressure developed is not great, and ordinary flasks may be used with little risk of breakage. W. P. S.

The Hydrogen-ion Concentration at which Iron is Precipitated from Hydrochloric Acid Solution by Ammonia, Sodium Hydroxide, and Hydrogen Sulphide. H. E. PATTEN and G. H. MAINS (*J. Assoc. Off. Agric. Chem.*, 1920, **4**, 233—235).—When a hydrochloric acid solution containing 0·03% of iron is treated with hydrogen sulphide, ammonia, or sodium hydroxide, the first appearance of a precipitate of ferrous sulphide or of colloidal ferric hydroxide occurs when the hydrogen-ion concentration is slightly above $P_H=3\cdot3$. W. P. S.

Volumetric Estimation of Iron in the Presence of a Large Quantity of Hydrochloric Acid. R. MEURICE (*Ann. Chim. anal.*, 1921, [ii], **3**, 23—25).—Ferrous salt solutions containing a large quantity of hydrochloric acid may be titrated with permanganate solution if potassium bromide is added to the iron solution and a current of air passed through the latter during the titration; the air is then bubbled through a mixture of potassium iodide solution and starch. As soon as all the ferrous salt has been oxidised, the next drop of permanganate solution added liberates bromine, and this is carried over into the potassium iodide solution, where a blue coloration develops. W. P. S.

New Process for the Separation and Estimation of Iron and Manganese. C. KOLLO (*Bul. Soc. Chim. România*, 1920, **2**, 89—95).—When hexamethylenetetramine is added to a solution of a ferric salt, the whole of the iron is precipitated as ferric hydroxide in the cold, even in acid solution. With manganous salts, a

precipitate of manganous hydroxide is only obtained in boiling neutral solution. If a solution of the tetramine in alcohol is added to a concentrated aqueous solution of manganous sulphate and sulphuric acid in equimolecular proportions, the crystalline double *sulphate*, $MnC_6H_{12}N_4,2H_2SO_4$, is obtained.

For the estimation of iron and manganese in the presence of one another, the mixture of salts is dissolved in water, acidified, and the iron entirely oxidised to the ferric state by means of hydrogen peroxide. A 10% solution of hexamethylenetetramine is then added until the whole of the iron is precipitated as ferric hydroxide, which is collected, dried, ignited, and weighed as the oxide. The filtrate is evaporated to dryness, a little sulphuric acid is added to the residue, and the evaporation is continued, the manganese being weighed as its sulphate. W. G.

Detection and Estimation of Nickel and Cobalt. MOTOOKI MATSUI and TADASU NAKAZAWA (*Mem. Coll. Sci. Kyoto*, 1920, **4**, 265—271).—Nickel hydroxide reacts directly with a 1% alcoholic solution of dimethylglyoxime. In presence of other hydroxides, nickel may be detected by boiling the mixed hydroxides for a short time with excess of dimethylglyoxime solution, diluting considerably with water, cooling, and shaking with ether. On keeping, the nickeldimethylglyoxime floats up with the ether. Cobaltdimethylglyoxime may be detected in solution by adding a drop or two of yellow ammonium sulphide solution, when a very intense red colour is produced if cobalt is present. The test is very delicate when a large excess of dimethylglyoxime is used, but since ferrousdimethylglyoxime also gives a red colour, iron must not be present. Attempts to find an insoluble double compound of cobaltdimethylglyoxime were unsuccessful, although a double lead–cobalt compound was obtained by adding lead acetate to a solution of cobaltdimethylglyoxime, in the form of orange-yellow crystals.

Alkaline solutions of the dimethylglyoxime compounds of nickel and cobalt were successfully electrolysed quantitatively, the metal forming a well-adhering deposit from a dilute solution, less than 0·05 gram per 100 c.c. It is thus possible to separate nickel and cobalt in the usual way with dimethylglyoxime and estimate both metals by electrolysis. A 5—6% solution of sodium hydroxide is used as the electrolyte and a current of 3·5 amperes with a rotating electrode, the temperature being below 50°. E. H. R.

Iodometric Estimation of Chromic Acid. I. M. KOLTHOFF (*Zeitsch. anal. Chem.*, 1920, **59**, 401—415).—The statements made in a recent paper (A., 1919, ii, 300) have been confirmed. Volumetric thiosulphate solutions may be standardised, with an error of less than 0·1%, by means of purified potassium dichromate, bromate or iodate, iodine, cyanogen iodide, or oxalic acid. Potassium dichromate commonly contains free chromic acid, and should be recrystallised from water several times and dried at 120°.

J. H. L.

Detection of Methyl Alcohol in Spirits. F. RABE (*Pharm. Zeit.*, 1921, **66**, 72).—When the morphine–sulphuric acid reagent is used for the detection of formaldehyde, resulting from the oxidation of methyl alcohol, care should be taken to expel all hydrochloric acid from the reagent if this is prepared by mixing morphine hydrochloride and sulphuric acid; the reagent itself soon develops a red coloration in the presence of hydrochloric acid. The resorcinol–sulphuric acid test is very sensitive for the detection of formaldehyde. W. P. S.

Detection of Methyl Alcohol in Spirits. G. MAUE (*Pharm. Zeit.*, 1921, **66**, 114—115).—The resorcinol–sulphuric acid test mentioned by Rabe (preceding abstract) for the detection of formaldehyde resulting from the oxidation of methyl alcohol is not new, and, further, it is not characteristic of formaldehyde, the coloration being also given by the oxidation products of allyl alcohol, formic acid, tartaric acid, etc. W. P. S.

Cholesterolanæmia. I. Comparative Investigations of [Analytical] Methods with Particular Reference to Colorimetric Processes. JOH. FEIGL (*Zeitsch. ges. exp. Med.*, 1920, **11**, 178—238; from *Chem. Zentr.*, 1921, ii, 97).—The author reviews the methods given in the literature and his own processes for the estimation of cholesterol, as a whole and as its component parts, in blood. He is led to the conclusions that the different colorimetric processes are trustworthy when accurately carried out, but contain many sources of error, and that the total cholesterol in the strictest sense cannot at present be estimated in this manner. The individual methods are not equal in value as judged from the pathological point of view, and further comparative investigations are necessary. Only small sections can be regarded as yielding practically useful values. H. W.

The Estimation of Dextrose in Blood and in Cephalorachidien Fluid. AL. IONESCU and V. VARGOLICI (*Bul. Soc. Chim. România*, 1920, **2**, 102—106).—The blood or fluid under examination is first defecated by the addition of a 20% solution of trichloroacetic acid. The filtrate obtained after defecation is neutralised by sodium hydroxide, and the dextrose present is estimated by its reduction of a solution of potassium ferricyanide (compare *ibid.*, 38). W. G.

Modifications of Bertrand's Method for Estimating very small Quantities of Sugar. L. AMBARD (*Bull. Soc. Chim. Biol.*, 1920, **2**, 203—205).—The author advises heating the sugar solution with the copper reagents in a centrifuge tube immersed in a water-bath. The precipitated cuprous oxide is collected by centrifugalisation, washed, and dissolved in the tube by adding the ferric sulphate solution. J. C. D.

Estimation of Sugar in Wine. W. FRESENIUS and L. GRÜNHUT (*Zeitsch. anal. Chem.*, 1920, **59**, 415—457).—The authors consider that the present German official methods for the estimation of sugars in wine require revision, and should be replaced by a scheme of analysis which is described in detail in the present paper. [Compare *J. Soc. Chem. Ind.*, 1921, 158A.] J. H. L.

Reactions of Sugars and Polyatomic Alcohols in Boric Acid and Borate Solutions, with some Analytical Applications. G. VAN B. GILMOUR (*Analyst*, 1921, **46**, 3—10).—Polyatomic alcohols, sugars, and a large number of hydroxy-compounds combine with boric acid with the production of stronger acids. On the addition of an excess of mannitol to a boric acid solution, mannitoboric acid, $C_6H_{12}O_6{:}BOH$, is formed; this, with sodium hydroxide, yields a salt which is stable in acid solution, but is hydrolysed to sodium metaborate and mannitol in alkaline solution, the metaborate then combining with a further quantity of mannitol to form compounds like $NaBO_2,3C_6H_{14}O_6$.

A method for the estimation of lævulose is as follows. Ten c.c. of *M*/10-boric acid solution and 0·5 c.c. of 1% phenolphthalein solution are added to a weighed amount of mixed sugars (honey, etc.) containing lævulose, and the mixture is titrated with *N*/10-sodium hydroxide solution; the amount of lævulose equivalent to the volume of sodium hydroxide used is obtained from the table:

Lævulose. Gram.	*N*/10-NaOH. Cc.	Lævulose. Gram.	*N*/10-NaOH. Cc.
0·22	7·2	0·36	8·9
0·27	8·1	0·40	9·2
0·31	8·5	0·45	9·5

W. P. S.

The Identification of Sulphonic Acids in the State of their Salts formed with Aromatic Bases. C. F. VAN DUIN (*Rec. trav. chim.*, 1921, **40**, 99—102. Compare Ambler, this vol., i, 21; Ambler and Wherry, this vol., ii, 68).—The author finds that sulphonic acids may be identified, where necessary, by titrating their salts of aromatic bases with *N*/10-sodium hydroxide in the presence of phenolphthalein as indicator (compare Franchimont and Backer, this vol., i, 9). This method was satisfactorily applied to *aniline* and p-*toluidine toluene*-o-*sulphonates*, m. p.'s 218° and 203—204° respectively; *aniline* and p-*toluidine toluene*-p-*sulphonates*, m. p.'s 237° and 199—200° respectively; *aniline* and p-*toluidine* 2:6-*dinitro*-1-*toluene*-4-*sulphonates*, p-*toluidine sulphanilate, aniline naphthalene*-β-*sulphonate*, m. p. 267—268° (decomp.), and to *di*-p-*toluidine toluene*-2:4-*disulphonate*, m. p. 277° (decomp.). W. G.

Separation and Identification of Lactic Acid as Complex Ferric Sodium Lactate. K. A. HOFMANN (*Ber.*, 1920, **53**, [*B*], 2224—2226).—Details are given of the preparation of a very pale

green, complex *ferric sodium lactate*, $[Fe(C_3H_4O_3)_2]Na,2H_2O$. This loses water at 80°, is almost insoluble in water at 20°, is only slowly attacked by dilute ammonia, sodium hydroxide, sodium hydrogen carbonate, 15% acetic acid, 1% hydrochloric acid or tannic acid, and is almost tasteless. When heated at 300°, or exposed to sunlight, it evolves acetaldehyde.

To separate lactic acid from fermentation products in the form of this salt, the solution should be mixed with little more than the required amount of ferric chloride, rendered alkaline with sodium carbonate, acidified with acetic acid, and evaporated on a water-bath. The characteristic precipitate separates in the course of a few hours

Corresponding potassium and ammonium salts are less stable, and are only partly precipitated, whilst no lithium salt has been obtained. J. C. W.

Identification of Acetaldehyde and Formaldehyde in Organic Liquids and Mixtures by means of New, Extremely Sensitive, Colour Reactions. EMILIO PITTARELLI (*Arch. Farm. sperim. Sci. aff.*, 1920, **30**, 148—160).—Acetaldehyde may be detected by adding, to 25—30 c.c. of the approximately neutral liquid to be tested, successively five to six drops of saturated (about $N/10$) phenylhydrazine hydrochloride solution, saturated diazobenzenesulphonic acid, 25% sodium hydroxide solution, and 50% magnesium sulphate solution; the last may be omitted if the colour appears after addition of the alkali hydroxide. A crimson coloration results, this beginning to appear almost instantaneously, although the reaction is complete only after some minutes; with the magnesium hydroxide, this yields a violet lake. In absence of either acetaldehyde or phenylhydrazine, only a yellow coloration is produced, this remaining unchanged by formaldehyde or acetone. The reaction is capable of detecting 1 part of acetaldehyde in 350,000 parts of solution, or 1 part of phenylhydrazine in 70,000 parts of solution.

To detect formaldehyde, 25—30 c.c. of the liquid under examination are treated in order with five to six drops of saturated phenylhydrazine hydrochloride solution, 1% metol solution, 25% sodium hydroxide solution, and 50% magnesium sulphate solution; here, too, the last may be omitted if it is unnecessary. In presence of formaldehyde, a blood-red coloration is formed, this giving a blue lake with the magnesium hydroxide. The reaction is capable of detecting 1 part of formaldehyde in 1,000,000 parts of solution, 1 part of phenylhydrazine in 250,000 parts of solution, and 1 part of metol in 300,000 parts of solution.

The above reactions may be applied directly to organic liquids and mixtures, such as urine, wine, milk, spirits, beer, foods, etc. T. H. P.

New Apparatus for Quantitative Sublimation. A. V. FULLER (*Chem. Analyst*, 1920, **29**, 6—10).—The apparatus

consists of two parts, the heater and the condenser. The heater is a glass tube about 18 cm. in length and 16 mm. in diameter, which is slightly tapered and ground at one end to fit gas-tight (without a lubricant) into one end of the condenser, which is a glass tube about 15 cm. in length and 19 mm. in diameter. The other, closed end of the condenser is indented to more than half the length of the condenser, forming an inner tube, through which cooling water can be passed. This end of the condenser also carries a side-tube, which can be attached to a pump

The condenser is closed by a ground-in stopper, and weighed. It is then attached to the heater containing a weighed amount of the substance to be sublimed, a slow current of air (1·3 litres per hour) is drawn through the apparatus, and the heater is carefully heated, preferably by external electrical heating. At the end of the operation, the air current is stopped when the tubes are cold, the inner tube of the condenser is dried with alcohol and with ether, and the stoppered condenser is re-weighed. The accuracy obtainable depends on the temperature of volatilisation, the temperature of condensation, and the time and rate of flow of the air current. In three experiments with 0·6085 gram of camphor, 0·6610 gram of naphthalene, and 0·3415 gram of benzoic acid, the temperatures of volatilisation were 130°, 130°, and 145°, the temperatures of condensation 12°, 20°, and 20°, and the recoveries 99·34, 99·97, and 100·06% respectively. CHEMICAL ABSTRACTS.

Estimation of Santonin in Wormseeds. TATSUO KARIYONE and YÛSHIRO KIMURA (*Off. Gaz. Japan*, 1920, 760—761; *J. Pharm. Soc. Japan*, 1920, 927—940).—The method depends on the estimation of the saponification value, utilising the lactone formation. Ten grams of powdered *Artemisia Cina*, Berg., are treated with ether for three hours in a Soxhlet apparatus. After distilling off the solvent, the residue is boiled with 100 c.c. of 5% baryta water, acidified with dry carbon dioxide, and filtered. Eighty c.c. of the filtrate (8 grams of sample) are extracted with 20 c.c. of chloroform with addition of 10 c.c. of 15% hydrochloric acid, filtered, and then extracted three times with 10 c.c. of chloroform. After distilling off the solvent, the residue is dissolved in 30 c.c. of ethyl alcohol by heating, cooled, and neutralised with $N/10$-potassium hydroxide, using phenolphthalein as indicator, boiled for thirty minutes under reflux with 20 c.c. of $N/10$-potassium hydroxide, cooled, and titrated with S c.c. of $N/10$-hydrochloric acid with addition of 0·5 c.c. of phenolphthalein. If S' is the amount of the acid required for neutralising 20 c.c. of $N/10$-potassium hydroxide which has been boiled with 30 c.c. of ethyl alcohol, then $2{\cdot}462(S'-S)/8$ gives the percentage of santonin. K. K.

Estimation of Urea in Blood. Actual State of the Question. M. LAUDAT (*J. Pharm. Chim.*, 1921, [vii], **23**, 5—15). —A full account of work on which two preliminary notes have been published (see A., 1920, ii, 645; this vol., ii, 70).

Estimation of Urea by Sodium Hypobromite. L. AMBARD (*Bull. Soc. Chim. Biol.*, 1920, **2**, 205—208).—A discussion of the technique of this method. A method for removing oxygen from the liberated gas is described. J. C. D.

Detection of Hydrogen Cyanide in Air. A. SIEVERTS and A. HERMSDORF (*Zeitsch. angew. Chem.*, 1921, **34**, 3—5).—A strip of filter-paper is dipped in a copper acetate–benzidine acetate solution and then exposed for seven seconds in the atmosphere to be tested; a blue coloration is obtained if the air contains 15 mg. or more of HCN per cubic metre. The reagent is prepared immediately before use by mixing equal volumes of copper acetate solution (2·86 grams per litre) and benzidine acetate solution (475 c.c. of cold saturated benzidine acetate solution and 525 c.c. of water). W. P. S.

A Direct Method for the Estimation of Dicyanodiamide in Cyanamide and Mixed Fertilisers. ROLLA N. HARGER (*J. Ind. Eng. Chem.*, 1920, **12**, 1107—1111).—The method depends on the precipitation of the dicyanodiamide with silver picrate; cyanamide and urea do not interfere, since they do not yield a precipitate with the reagent. In the case of mixed fertilisers, 20 grams of the sample are mixed with 50 c.c. of water, 100 c.c. of saturated barium nitrate solution are added, the mixture rendered alkaline with barium hydroxide, shaken for thirty minutes, diluted to 500 c.c., and filtered. To 200 c.c. of the filtrate are added 15 c.c. of 5% silver nitrate solution, the mixture is filtered if silver chloride forms, and then treated with 100 c.c. of saturated picric acid solution. The mixture is cooled at 0° for thirty minutes, the crystalline precipitate then collected on a weighed asbestos filter, washed with water saturated with the compound (a precipitate from a former analysis can be used for this purpose), then with ether, dried at 100°, and weighed. The weight found is increased by 0·0044 gram for each 100 c.c. of solution from which the crystals were filtered, and the result is divided by 5 to obtain the amount of dicyanodiamide. W. P. S.

Estimation of Aniline and its Titrimetric Diazotisation. TH. SABALITSCHKA and H. SCHRADER (*Zeitsch. anal. Chem.*, 1921, **34**, 45).—Aniline cannot be estimated quantitatively by precipitation with excess of a ferric salt or with formaldehyde, neither can it be accurately titrated with acid in presence of any known indicator. The statement in many text-books, that the red colouring matter of dahlias constitutes a suitable indicator for this purpose, is incorrect. Aniline may be titrated accurately with $N/1$-sodium nitrite solution, with the aid of potassium iodide–starch test paper as external indicator. The liquid should contain at least 2—3 mols. of sulphuric acid to 1 mol of aniline, and be cooled with ice-water, whilst the nitrite solution is added a few drops at a time and later drop by drop until the nitrite reaction

persists for fifteen minutes. [See, also, *J. Soc. Chem. Ind.*, 1921, Mar.] J. H. L.

Methyl-red as Indicator in the Estimation of Alkaloids. A. Eberhard (*Apoth. Zeit.*, 1920, **35**, 318—319; from *Chem. Zentr.*, 1920, iv, 659).—The applicability of methyl-red as indicator in alkaloidal estimations in the place of hæmatoxylin or iodoeosin is confirmed for methods similar to that of Herzog (*Apoth. Zeit.*, 1920, **35**, 216). H. W.

Estimation of Theobromine in Cocoa and its Products. Raymond V. Wadsworth (*Analyst*, 1921, **46**, 32—37).—Ten grams of the substance are mixed with 3 grams of magnesium oxide and 14 c.c. of water, dried partly, but not completely, and then boiled under a reflux apparatus for thirty minutes with 150 c.c. of tetrachloroethane. The mixture is filtered while hot, and the residue again extracted with tetrachloroethane. The united extracts are distilled to reduce the volume to about 5 c.c., and this residual liquid, when cold, is mixed with 70 c.c. of ether. After eighteen hours, the precipitated theobromine is collected, washed with ether, dried at 100°, and weighed. To the weight obtained is added 0·004 gram to correct for the solubility of the precipitate in the 70 c.c. of ether. Cocoa beans require extraction with light petroleum to remove excess of fat previous to the estimation of the theobromine. W. P. S.

New Method for the Estimation of Histidine. W. E. Thrun and P. F. Trowbridge (*J. Assoc. Off. Agric. Chem.*, 1920, **4**, 194—195).—The method is used in conjunction with the Van Slyke method, and depends on the absorption of bromine by histidine and cystine. A portion of the solution containing the bases of a coagulable protein is treated with bromide–bromate solution and hydrochloric acid, and, after fifteen minutes, the excess of bromine is titrated. Cystine is estimated separately in another portion of the solution by estimating the sulphur content. One molecule of cystine absorbs 10 atoms of bromine, whilst 1 molecule of histidine absorbs 2 atoms of bromine; there is some evidence, however, that the latter absorption somewhat exceeds 2 atoms of bromine. W. P. S.

Estimation of Morphine in Opium and certain of its Preparations. Trifon Ugarte (*J. Pharm. Chim.*, 1921, [vii], **23**, 129—131).—One gram of powdered opium is heated on a water-bath for five minutes with 10 c.c. of 67% alcohol, the alcoholic solution then filtered, and the insoluble residue extracted three times with alcohol in a similar way. The united alcoholic extracts are evaporated, the residue dried at 100° for fifteen minutes, then dissolved in 5 c.c. of cold water, the solution filtered, and any insoluble substance extracted with successive quantities of water,

using 20 c.c. in all. The aqueous solution is evaporated, the residue dissolved in 2 c.c. of water saturated previously with morphine, 3 c.c. of $N/1$-ammonia solution, also saturated with morphine, and 10 c.c. of ether are added, and the mixture is agitated thoroughly; 20 c.c. of ether are next added, the mixture stirred, and, after thirty minutes, the crystalline precipitate of morphine is collected, washed with water saturated with morphine and ether, dried at 100°, and weighed. In the case of opium tincture, 10 c.c. of the sample are evaporated, the residue dried, extracted with cold water, and the estimation proceeded with as described. W. P. S.

The Separation of Ptomaines from Vegetable Alkaloids in Toxicological Examinations. AL. IONESCU (*Bul. Soc. Chim. România*, 1920, **2**, 82—89).—In an endeavour to find a ready method of distinguishing between vegetable alkaloids and ptomaines in the presence of one another, the author has examined the influence of certain enzymes on the ptomaines and on strychnine, coniine, and morphine as typical of three classes of alkaloids, and the influence of the ptomaines and the alkaloids on the activity of the enzymes. The material under examination was acted on for twenty-four hours by the enzyme under the optimum conditions, and the alkaloids and ptomaines then extracted by Dragendorf's method, using either benzene or amyl alcohol as solvents. Hydrolysing enzymes of the type of invertase and amylase have no action on the ptomaines, whilst pepsin weakens their reducing power without affecting their alkaloidal character. Tyrosinase and peroxydase destroy only the reducing power of the ptomaines. Neither the ptomaines nor the alkaloids affect the activity of the enzymes. Under the experimental conditions the vegetable alkaloids examined were not affected by any of the enzymes used. W. G.

Peru Balsam and its Adulteration. L. VAN ITALLIE (*Amer. J. Pharm.*, 1921, **93**, 24—26).—A sample of Peru balsam having the consistency of a thin syrup gave, on examination, D 1·146; acid number, 48·8; saponification number, 356; cinnamein content, 70%; saponification number of the separated cinnamein, 382. The high saponification numbers of the balsam and cinnamein indicated adulteration with an ester, and the presence of methyl phthalate was shown by the fluorescein test with resorcinol and sulphuric acid applied either to the balsam or the separated aromatic ester. Such adulteration of balsams may also be recognised by Dietrich's test (*Ber. Deut. pharm. Ges.*, 1908, 142). Benzoyl benzoate is also used as an adulterant, and its presence, although not indicated by the saponification number, may be shown by the fluorescein test or by Dietrich's test W. G.

Estimation of Uric Acid in Blood by Folin's Method. I. A. ZALESKI and (MISS) A. A. SACHNOVSKA (*Russ. Physiol. J.*, 1919, **2**, 14—35).—Experiments have been made to test the accu-

racy of the results yielded by Folin's method (Folin and Macallum, A., 1912, ii, 495; 1913, ii, 80; Folin and Denis, A., 1913, ii, 162, 444), which depends on comparison in a colorimeter of the intensities of the blue colorations obtained when the uric acid solution to be tested and a standard uric acid solution are treated with phosphotungstic acid in presence of an alkali. The authors suggest various modifications in the procedure. The magnesium–silver salt, in the form of which the uric acid is separated from the blood, is best decomposed, not by hydrogen sulphide, but by hydrochloric acid, the silver chloride being then removed by filtration from the uric acid solution; this alteration shortens the time required by the estimation very considerably. For determining the intensity of the blue coloration obtained with the phosphotungstic reagent, use is made of blue glasses previously standardised with the help of uric acid solutions of known concentrations. The method admits of the estimation of the amount of uric acid in 10 c.c. of blood with an error of at most 0·05 m. gram. T. H. P.

New Method for the Estimation of Uric Acid in Blood. ALEKSANDER OSEACKI (*Przeglad. Lekarski, Krakau*, 1920, **59**, No. 4; from *Chem. Zentr.*, 1921, ii, 97).—Serum (20—50 c.c.) is diluted with 4—14 times its volume of water and freed from albumin by treatment with uranyl acetate solution (1·5%, in volume equal to that of the serum). The precipitate is filtered, dissolved in a warm mixture of water (equal in volume to the filtrate), and $N/2$-sodium hydroxide solution, re-precipitated with $N/2$-acetic acid, and filtered whilst hot. Uric acid is separated in the usual manner from the combined and concentrated filtrates. H. W.

Apparatus for Estimating the Catalase Content of Milk. A. MACHENS and FR. CORDES (*Milch. Zentr.*, 1921, **50**, 25—27).—Two similar bottles are connected at their shoulder by a short tube fitted with a three-way tap; at the bottom of one bottle is a tubulure which is connected with a vertical graduated tube. This bottle is filled with water so that the level of the latter is at the zero mark on the tube. Fifteen c.c. of milk are placed in the other bottle, both are closed with stoppers, and the whole apparatus is placed for fifteen minutes in an oven heated at 37°, the three-way tap being turned so as to place both bottles in communication with the atmosphere. Five c.c. of 1% hydrogen peroxide are then added to the milk, the tap is turned to place the bottles in communication with each other, and the apparatus is kept at 37°. The evolution of gas increases the pressure in the apparatus, and this pressure is indicated by the water rising up the graduated tube.

W. P. S.

Application of the Precipitometer and of an Apparatus for the Estimation of Catalase to the Study of the Course of Alcoholic Fermentation. K. SCHWEIZER (*Bull. Assoc. Chim. Sucr.*, 1920, **38**, 163—171).—For the measurement of yeast growth

in fermentation experiments the author recommends treating portions of the culture with sodium carbonate solution and centrifuging for five minutes at 2000 revs. per min. in a tube with a constricted graduated end (precipitometer). For the measurement of the gas evolved, an apparatus devised by Koestler (*Jahresb. Molkerei Ruetti*, 1909) for the estimation of catalase is recommended. J. H. L.

The Water-soluble Vitamin and the Substances Accelerating Fermentation. I. A Method for the Estimation and the Preparation of a Substance from Yeast and Rice Polishings which Accelerates Fermentation. SIGMUND FRÄNKEL and ERIK SCHWARZ (*Biochem. Zeitsch.*, 1920, **112**, 203—235).—Utilising the fact that extracts from yeast and rice polishings accelerate fermentation, the authors have worked out a method by means of which the accessory factor can be estimated. An active fraction from yeast is prepared in the following way. The yeast is extracted with 80% alcohol, and, after removal of the fats, is treated with basic lead acetate. The lead in the active filtrate is removed with hydrogen sulphide, and the filtrate further precipitated with mercuric chloride. The precipitate is then decomposed with hydrogen sulphide, freed from hydrochloric acid, and concentrated in a vacuum. The concentrated syrup is precipitated with picrolonic acid, which removes an inactive picrolonate, and the active substance is precipitated with phosphotungstic acid. The precipitate is decomposed with baryta and sulphuric acid, and concentrated in a vacuum. The sulphate of the active base thus obtained is twenty-two times more potent than the original alcoholic extract. S. S. Z.

A Microchemical Reaction of Pulmonary Epithelial Tissue. E. FAURÉ-FREMIET, J. DRAGOIU, and (MLLE) DU VIVIER DE STREEL (*Bull. Soc. Chim. Biol.*, 1920, **2**, 166—170).—The test depends on the treatment of the tissue with a reagent containing formaldehyde and cadmium chloride. The presence of sulphur in the tissues causes a deposit of cadmium sulphide to be formed.

J. C. D.

General and Physical Chemistry.

The Molecular Refraction Coefficient, its Additivity and its Use for Determining Constitution. III. Numerical Relationships in the Series of Polymethylene Compounds. FRITZ EISENLOHR (*Ber.*, 1921, **54**, [*B*], 299—320. Compare A., 1920, ii, 717; this vol., ii, 1).—In previous papers it has been pointed out that the "molecular coefficient of refraction," $M \times n_D^{20}$, is more sensitive to constitutive changes in the molecule than the generally employed molecular refraction, and values have been calculated for aliphatic and benzenoid compounds. In the present communication, polymethylene compounds are similarly considered, but, for the time being, the treatment is limited to the *trans*-isomerides which are in general obtained by Sabatier's method of hydrogenation in the presence of nickel. In contrast to the behaviour of benzenoid derivatives, in which the number of side chains appears to have more influence on the *E* value than their position, it is found with the *cyclo*-paraffins that the data are more affected by the location than by the number of side chains.

The author draws the conclusion that the refractive index in the form of the "molecular coefficient of refraction" can be used in this series for distinguishing between compounds of very closely allied structure. The differences between the observed values and those calculated for the individual components and linkings (*E* values) not only throw great light on the molecular structure, but also serve as criteria of the degree of purity of the substances. The natural expression of peculiarities of constitution is found in the index of refraction itself. The combination of this value with that of density in the usual molecular refraction is unfortunate, since the two constants are frequently influenced in much the same degree by constitutive changes, and the data thus obtained are only useful in explaining molecular structure in certain definite cases such as those in which conjugated double bonds, for example, are present.

H. W.

Spectro-chemistry of Benzene Derivatives. K. VON AUWERS [with ADELHEID FRÜHLING] (*Annalen*, 1921, **422**, 160—191).—The ordinary physical constants and the refractive indices for light of various wave-lengths have been measured for a large number of benzene derivatives of the following classes.

1. *Halogen Derivatives.*—In all cases the molecular refraction and dispersion are either normal or almost so, indications of exaltation being exhibited only with isolated compounds. Just as in aliphatic compounds, halogens and alkyl groups are here spectrochemically similar, entry of a substituent of either type into the benzene nucleus disturbing the optical neutralisation of the double linkings, and thereby enhancing the refractive and dispersive properties; this effect is less marked with the halogens than with the alkyls.

2. *Phenols and their Ethers.*—The results obtained confirm the observation that the differences in exaltation shown by isomeric phenols or by their ethers lie within very narrow limits. This absence of apparent relations between structure and physical constants is especially pronounced with the free phenols. Phenol ethers with two ortho-substituents differ markedly from the others, their boiling points, densities, refractive indices, molecular refractions, and molecular dispersions being lower than those of their isomerides; the differences are, indeed, so great that an *oo*-derivative may be recognised by means of any of these constants except the density. Just as with aromatic hydrocarbons and with the various classes of hydroaromatic compounds, so with the phenol ethers the exaltations are greatest with the symmetrical compounds, but the differences for the isomerides are not great. Other regularities, similar to but less marked than those occurring with the hydroaromatic alcohols, are also observed.

3. *Amines.*—With the four xylidines no relations of particular interest are detectable.

From these and previous results the general conclusion is drawn that, with increasing separation of the substituents the exaltations of benzene derivatives increase, whilst with increasing approximation they diminish.

Of the compounds considered the following are new.

Ethyl o-*chlorocinnamate* (compare Gabriel and Herzberg, A., 1883, 1123) has b. p. 160°/16 mm.

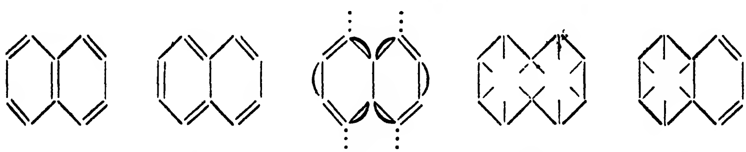
3 : 4 : 5-*Trimethylphenyl methyl ether* (*hemellithenol methyl ether*), $C_{10}H_{14}O$, crystallises in flat, oblique, shining prisms, m. p. 28—29°, b. p. 226—227°, the corresponding *ethyl* ether, $C_{11}H_{16}O$, being a colourless oil, b. p. 237—238°.

2 : 4 : 6-*Trimethylphenyl ethyl ether* (*mesitol ethyl ether*), $C_{11}H_{16}O$, forms a colourless oil, b. p. 217°. T. H. P.

Spectro-chemistry of Polynuclear Aromatic Compounds, and Constitution of Naphthalene. KARL VON AUWERS and ADELHEID FRÜHLING (*Annalen*, 1921, **422**, 192—230).—The results obtained for a large number of naphthalene derivatives indicate first, a general uniformity of the specific exaltations, and, secondly, dispersions which, in comparison with the highly augmented refractivities, are only moderately increased. These peculiarities, which are especially pronounced when the data obtained are compared with those of the benzene derivatives, confirm the rule that every class of compounds exhibits a typical spectro-chemical behaviour. In general, substituents are optically of little influence in the naphthalene series, but the halogens furnish an exception to this rule, the exaltations for the halogenated naphthalenes being only about one-half of that for the parent substance, although the dispersive power remains virtually unaltered. Whether highly unsaturated side-chains, such as the aldehyde or vinyl group, exert marked influence on the spectrochemical constants of naphthalene, is yet undecided. With the exception of 4-methoxy-1-naphthaldehyde, no derivative shows a higher exaltation than naphthalene

itself, so that the action of substituents in the naphthalene molecule, unlike that in the benzene molecule, is mostly depressive. It is noteworthy that in certain cases, particularly with esters, the dispersive power increases when the optical exaltation falls, so that refraction and dispersion seem to be mutually less dependent in the naphthalene series than in other groups of compounds. The influence of position is slight, although the optical exaltations are, on the average, somewhat higher with the β- than with the α-derivatives. In its optical constants acenaphthene corresponds perfectly with mono- and di-alkylnaphthalenes, the rule that the formation of a saturated ring does not alter the spectrochemical character being thus obeyed.

The bearing of these results on the various structures which have been proposed for the naphthalene molecule is discussed at length. The conclusion reached is that formula I, as originally interpreted



(I.) (II.) (III.) (IV.) (V.)

by Erlenmeyer, and also formulæ III, IV, and V are incompatible with the spectrochemical data. No choice is, however, yet possible between formula I, if this be taken to represent benzene with an unsaturated cyclic side-chain, and formula II, expressing a hydro-aromatic structure.

The following compounds containing two benzene nuclei, variously united, have also been examined: diphenylmethane, *p*-methyldiphenylmethane, *m*-methylstilbene, diphenyl, *oo*-diphenol diethyl ether, diphenylene oxide, 9-methylfluorene, and fluorenone. Diphenylmethane behaves spectrochemically as a hydrocarbon of the benzene series, but when the chain between the two rings is unsaturated, as in methylstilbene, marked exaltation appears; the latter is also the case with diphenyl and its *oo*-diethoxy-derivative. Conversion of diphenyl into the tricyclic compounds, diphenylene oxide and fluorene, would be expected either to leave unaltered or to lower the exaltation of the parent substance, whereas the reverse is actually the case; fluorenone also exhibits unexpectedly high exaltation. Doubt is thus cast on the presence in the molecules of these tricyclic compounds of two true benzene nuclei; the double linkings of the two external rings no longer exist in a condition of optical neutralisation, but have assumed a more or less olefinic character, as in naphthalene and anthracene. That the ring-closure has really effected a fundamental change in the nature of the double linkings is indicated also by a comparison of the chemical properties of diphenylmethane with those of fluorene. In the former the methylene group between the two benzene rings is chemically indifferent, as it cannot be influenced by the mutually neutralised valencies of the benzene. In fluorene, on the other

hand, the hydrogen atoms of the uniting methylene group are highly reactive, being under the influence of two olefinic double linkings.

The following new compounds have been prepared. 2 : 3-*Diamyloxynaphthalene*, $C_{10}H_6(O{\cdot}C_5H_{11})_2$, forms a very viscous, pale yellow oil, b. p. 229—230°/20 mm., and the isomeric 2 : 7-*compound*, slender, white needles, m. p. 75°, b. p. 236—237°/13 mm.

Ethyl 1-*methoxy*-2-*naphthoate*, $C_{14}H_{14}O_3$, forms a very viscous, colourless oil, b. p. 184—185°/14 mm. 3-*Methoxy*-2-*naphthoic acid*, $C_{12}H_{10}O_3$, forms small, pale yellow crystals, m. p. 133—134°, and its *ethyl* ester, a colourless, highly viscous oil, b. p. 208·5°/18 mm. or white crystals, m. p. about 18°; the *silver* salt was analysed.

m-*Methylstilbene*, $C_6H_5{\cdot}CH{:}CH{\cdot}C_6H_4Me$, prepared by the slow distillation of *m*-tolyl cinnamate (compare Anschütz, A., 1885, 1064), forms stout, white crystals, m. p. 52·5—53·5°, b. p. 206—207°/30 mm. T. H. P.

Optical Properties of some Crystals in the Long-wave Infra-red Spectrum. III. TH. LIEBISCH and H. RUBENS (*Sitzungsber. Preuss. Akad. Wiss. Berlin*, 1921, 211—220; see A., 1920, ii, 402).—The investigations previously described were extended to wurtzite, zircon, rutile, strontianite, and cryolite. The reflection capacity of wurtzite is less than that of regular zinc blende. The results with zircon were obtained with a better specimen than previous measurements, and gave higher reflection capacities than previously recorded. The high reflection capacities of rutile confirmed the high value of the dielectric constant of this mineral. J. R. P.

Criticism of Bohr's Theory of the Emission of Light. J. STARK (*Jahrb. Radioaktiv Elektronik*, 1920, **17**, 161—173. Compare Sommerfeld, Atombau, and Spektrallinien, Braunschweig, 1919).—A criticism of Bohr's theory of the emission of light in which it is shown that this hypothesis has been able to give, a quantitative deduction of the Balmer series formula and thereby the Rydberg constants; a quantitative representation of the effect of an electric field on the hydrogen series lines both with regard to the number and separation of the components, and also a deduction of the Zeeman triplets. These three services are obtained by means of three unsatisfactory assumptions, so that the solution of three difficulties has been obtained by the introduction of three new difficulties. The Bohr hypothesis proves the existence, in opposition to a number of observations, of the Doppler effect with canal rays, continuous spectra of atoms, the intimate structure of hydrogen and helium lines, the Zeeman effect of neighbouring line components in strong fields, whilst it does not indicate the dissymmetry of the intensity in the effect of the electric field on the hydrogen series lines. J. F. S.

The Corpuscular Spectra of the Elements. MAURICE DE BROGLIE (*Compt. rend.*, 1921, **172**, 274—275, 527—529).—A study of the corpuscular spectra of the elements from molybdenum to

barium shows the K rays of these elements transposed in the form of corpuscular rays. At the portion of the spectrum corresponding to the absorption band K of the elements there is a selective emission band of the photo-electric corpuscles with a sharp border at the side of the feeble energies. Thus the electrons from the commencement of the band possess the velocity corresponding with the quantum of the discontinuity of absorption of the X-rays, the band extending from the side of the greatest velocities. Thus in the corpuscular spectra of the elements all the characteristics of the X-ray spectra are found. W. G.

Action of the Red and Infra-red Rays on Phosphorescent Substances. MAURICE CURIE (*Compt. rend.*, 1921, **172**, 272—274).—The author has used simultaneously exciting and extinguishing radiations, the former from a mercury lamp with a glass-filter with nickel oxide, and the latter from an arc lamp with a glass-filter strongly charged with copper oxide. Under these conditions with phosphorescent zinc sulphide there can be observed, at the place where the infra-red rays are concentrated, a black spot on a background of bright luminosity. If the plate of sulphide is moved the brilliancy is reinforced, a luminous spot appearing, followed by a very dark trail behind the passage of the infra-red rays. This reinforcement of brilliancy varies in intensity and duration with the phosphorescent substance. With a fluorescent substance it is not possible to observe any spot or any variation in brilliancy at the place where the infra-red rays are concentrated. W. G.

Optical Rotation of Mixtures of Sucrose, Dextrose, and Lævulose. WARREN C. VOSBURGH (*J. Amer. Chem. Soc.*, 1921, **43**, 219—232).—The optical rotation of mixtures of sucrose, lævulose, and dextrose, dextrose and sucrose, lævulose and sucrose, and dextrose and lævulose has been measured for a series of mixtures of different concentrations at 25°, using either sodium light or the light from a mercury vapour lamp filtered through a No. 74 Wratten filter. It is shown that the specific rotations of dextrose and lævulose when mixed in equal proportions in solution (invert-sugar) are those which the sugars would have if each were present alone at a concentration equal to the total invert-sugar concentration. In other words, the angular rotation of an invert-sugar solution is equal to one-half the algebraic sum of the rotations of solutions of dextrose and lævulose of the same concentration. The specific rotations of dextrose and sucrose in mixtures of the two are those which the sugars would have if each were present alone at a concentration equal to the total sugar concentration. This relationship is only approximate for mixtures of lævulose and sucrose, in which case the angular rotation is a little smaller (or larger numerically if negative) than that calculated. The polariscopic determination of the percentage of sucrose replaced by invert-sugar gives slightly high results; this applies whether the source of light in the measurements is that of the sodium flame or a suitably purified mercury flame. In the latter case the error

is not so large as in the former case. The presence of a constant amount of hydrochloric acid at a concentration, $0{\cdot}1N$, sodium chloride $0{\cdot}1N$, or sodium carbonate $0{\cdot}04N$ has no effect on the percentage determinations of sucrose when the rotations of the pure sucrose and invert-sugar are determined under the same conditions as in the case of the mixtures. The error introduced by the polariscopic method of analysis is small enough to be neglected in most sucrose hydrolysis investigations, both in hydrolysis by acids and hydrolysis by invertase when properly carried out in the latter case. It is such as to cause neither increasing nor decreasing velocity coefficients, but would cause the coefficients to be too high by about 4 parts in a thousand when sodium light is used, and quite appreciably less in error if mercury-vapour light is used in the polariscopic measurements. J. F. S.

Relation of Molecules to Slow Free Electrons. H. F. Mayer (*Ann. Physik*, 1921, [iv], **64**, 451—480).—The absorption of very slow cathode rays in hydrogen, nitrogen, carbon dioxide, helium, and argon was investigated. With velocities below 8 volts the absorbing cross-section of the molecules remained constant except in the case of argon, in which case the specific capacity of absorption increased to a maximum with diminishing speed to 12 volts and then diminished to a very small value. Argon possesses a pronounced selective absorption; the other gases show no selective absorption. J. R. P.

Spectrum-analytical Investigations of the Canal and Cathode Rays of the Positive Point Discharge in Oxygen and Nitrogen. Albert Schultz (*Ann. Physik*, 1921, [iv], **64**, 367—375).—In the spectrum of the positive point current in oxygen the spark lines, series lines, doublet lines of the second arc spectrum, the first band spectrum and ozone bands were observed. In nitrogen, positive bands, negative bands, and spark lines were found. In the positive point current, slow cathode rays, rapid cathode rays and slow canal rays, corresponding with two regions of ionisation, occur. The distribution of intensity of the lines may be explained on the following assumptions. The carrier of the series lines of oxygen is the univalent atom-ion; that of the spark lines is the bivalent atom-ion. The carrier of the negative bands in nitrogen is the bivalent diatomic molecule-ion, N_2^{++}, that of the positive bands the univalent diatomic molecule-ion N_2^{+}. In the canal rays of the positive point current changes of charge occur; in nitrogen from bivalent to univalent molecule-ions and in oxygen from bivalent to univalent atom-ions. J. R. P.

Röntgenograms obtained by Means of Mica Piles composed of Crossed Lamellæ. F. M. Jaeger (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 676—678).—Further experiments have shown that the conclusion reached in a former paper (A., 1920, ii, 601) that the Röntgen ray images obtained from a system of mica lamellæ crossing at definite angles were not mere super-

positions of the images obtained from each of the composing lamellæ separately, cannot be maintained. E. H. R.

Radioactive Constants according to the Position in 1920. STEFAN MEYER (*Jahrb. Radioaktiv Elektronik*, 1920, **17**, 80—87).—Tables of constants deduced from the most trustworthy data are given for the various families of radioactive elements. The tables include the half life, disintegration constant, the average life, the initial velocity of the corpuscles, the absorption coefficient for aluminium and lead, and the range of the particles. J. F. S.

Power of Emission of the Metals and Methods for its Determination. F. HENNING (*Jahrb. Radioaktiv Elektronik*, 1920, **17**, 30—62).—A theoretical discussion on the emissivity of metals in which it is shown from the investigations of Hagen and Rubens (A., 1909, ii, 358; 1910, ii, 262, 469), that the formulæ $A = 1 - R = 0{\cdot}365\ (\gamma/\lambda)^{1/2} - 0{\cdot}0667\ \gamma/\lambda + 0{\cdot}0091)\ (\gamma/\lambda)^{3/2} - \ldots$ and $A = 0{\cdot}365\ \sqrt{\gamma/\lambda}$ in which A is the power of absorption and R the reflection, represent the absorptive power of the metals for long wave-lengths (26μ). At the wave-length $\lambda = 8{\cdot}85\mu$ marked deviations from the theory are already observed, which, however, only show themselves in the absolute quantity and do not appear in the temperature coefficient of the absorptive power. The temperature coefficient is still in fair agreement with theory for wave-lengths $4—5\mu$, but on passing to still shorter wave-lengths it suddenly deviates from the theoretical value, and at 2μ the absorptive power of the metals is independent of the temperature, whilst at longer wave-lengths it has a positive temperature coefficient. The absorptive power of tantalum and the platinum metals in the visible spectrum is constant. In the case of tungsten, experimental results of various observers are at variance; some regard it as constant whilst others assign a negative or a positive temperature coefficient to it. The radiation properties of tungsten are very much influenced by impurities, and this probably accounts for the above-mentioned diversity in the results. Many observers have found that molten gold, silver, copper, nickel, palladium, and platinum have a stronger power of emission in red light and a weaker power of emission in blue light than the solid metals, whilst in the case of molten tungsten Langmuir (*Phys. Rev.*, 1915, **6**, 138) has found that it radiates weaker in red light than the solid metal, whilst Bidwell (*Phys. Rev.*, 1914, **3**, 439) only found a difference when oxygen was present. In calculating the intensity of radiation in the visible region the following values of the power of emission are recommended where the λ values are given in 0·001 mm.

λ.	Ag.	Au.	Pd.	Pt.	Rh.	Ir.	Ta.	W.
0·45	0·10	0·67	—	0·45	—	—	—	0·52
0·50	0·09	0·53	—	0·42	0·24	0·28	0·62	0·51
0·55	0·07	0·26	—	0·39	0·23	0·27	0·60	0·50
0·60	0·07	0·16	0·33	0·36	0·22	0·25	0·58	0·49
0·65	0·06	0·11	—	0·33	0·21	0·24	0·56	0·47
0·70	0·05	0·08	—	0·31	0·20	—	—	0·46

J. F. S.

Work of Ionisation and Dissociation of Hydrogen. THEA KRÜGER (*Ann. Physik*, 1921, [iv], **64**, 288—304).—The first strong ionisation of hydrogen occurs at $17 \cdot 1 \pm 0 \cdot 25$ volt, the second at $30 \cdot 4 \pm 0 \cdot 5$ volt. The first value is attributed to the dissociation of the molecule and the ionisation of one atom; the second value is supposed to correspond with the dissociation of the molecule and the ionisation of both atoms. The work of dissociation of the molecule is thus calculated as $3 \cdot 5 \pm 0 \cdot 3$ volt, or 81300 ± 5700 gram cal.

At 11 volts weak ionisation, and at 13·5 volts radiation occur. The radiation at 13·5 volts is attributed to dissociation of the molecule with simultaneous resonance radiation of one atom; the value 11 volts is assumed provisionally as the energy of formation of a hydrogen molecule. J. R. P.

The Electrical Resistance of Nickel Steels. A. PORTEVIN (*Compt. rend.*, 1921, **172**, 445—447).—The electrical resistance of nickel steels depends to a considerable extent on the conditions of annealing. Differences of 10—40% in the value were obtained with steels containing 0·3—0·8% of carbon and 7—15% of nickel, according as the samples were heated to 1000° and cooled during 4—5 hours or heated to 1300° and cooled during three days. This variation in the electrical resistance may or may not be accompanied by characteristic modifications of the micro-structure. Curves are given showing the variation in resistance of nickel steels according to their carbon and nickel content. W. G.

Zinc Electrode. WILLIAM C. MOORE (*J. Amer. Chem. Soc.*, 1921, **43**, 81—84).—Reproducible and trustworthy measurements of the potential difference of zinc electrodes can only be obtained when the solutions are made with freshly boiled water from which all oxygen is excluded by a constant stream of hydrogen. Even this arrangement does not indicate small changes in the zinc ion concentration, and it is suggested that substituting a dilute zinc amalgam for the zinc rod will probably give satisfactory results in these cases. J. F. S.

The Mobility of Univalent Organic Ions. G. VON HEVESY (*Zeitsch. Elektrochem.*, 1921, **27**, 77—78).—A reply to Lorenz's criticisms (A., 1919, ii, 212). The contradiction between the author's results and those of Lorenz is only apparent. Most univalent organic ions are already so large, and consequently the strength of their electrical field is so small, that they do not become hydrated. Lorenz's objections to the author's views would only hold (*a*) if univalent organic ions were known with mobilities greater than 60, and (*b*) if ions exceeding the "normal" size became hydrated. E. H. R.

Depolarisation by Light. EMIL BAUR (*Zeitsch. Elektrochem.*, 1921, **27**, 72—77).—From the work of Staechlin on the effect of fluorescent dyes on the *E.M.F.* of illuminated cells (A., 1920, ii, 580), it was to be expected that a light-sensitive substance in an

electrolytic cell would have a depolarising action in the light. Experiments were made to test this conclusion by comparing the current-tension curves of such cells in the light and dark respectively. The cells used contained dilute sulphuric acid solutions of uranyl sulphate or quinine sulphate, or a dilute sodium carbonate solution of eosin. The electrodes were of platinum and the cells were so arranged that the anode or cathode separately or both together could be illuminated by means of a 3000 candle-power half watt lamp. A variable *E.M.F.* was applied to the cell and the current–*E.M.F.* curve was plotted, or alternatively, with a constant *E.M.F.*, the current–time curve was plotted for the illuminated and unilluminated cell. In each case the depolarising effect of the light-sensitive substance was clearly shown in the illuminated cell. In the case of uranyl sulphate the cathode effect (with only the cathode illuminated) was much smaller than the anode effect, whilst with quinine sulphate and eosin this difference did not appear in the current–*E.M.F.* curves, although it was clearly marked in the current–time curves with constant *E.M.F.* By rotating or shaking the cell it was possible to get a higher current with a given *E.M.F.* in either the illuminated or unilluminated cell, but in each case the illuminated cell gave a much higher current. A shaken, illuminated cell gave for 20 hours a constant current actually higher than the initial current of the same cell in the dark. It must be concluded that polarisation has an immediate effect on the current strength in the dark. The experiments show that the depolarising effect of light is in agreement with the hypothesis of a concealed water-photolysis (Staechlin, *loc. cit.*). E. H. R.

The Magnetisability of the Rare Earths. E. WEDEKIND [with P. HAUSKNECHT] (*Ber.*, 1921, **54**, [*B*], 253—258. Compare A., 1915, ii, 140).—The following values have been obtained for the atomic magnetism, $\gamma\alpha \times 10^{-6}$, of a series of metals of the rare earths, the observations being made with spectroscopically pure specimens of the oxides, sulphate, and oxalates :

	Sc.	Y.	La.	Ce^{iii}.	Ce^{iv}.	Pr.	Nd	Sm.	Gd.	Er.
Oxide	−1·2	+8·7	−18·3	—	+74·4	+4740	+5100	+8300	+9850	+40,600
Sulphate	−62·5	−57	−84	+2200	+37·5	+5100	+5270	—	—	+36,700
Oxalate	−65	—	—	—	—	+5000	+5380	—	+9430	+35,800

The values for scandium, yttrium, and lanthanum are too small to be regarded as trustworthy.

If the values for the atomic magnetism are plotted against atomic weights a graph is obtained which shows a flat maximum at yttrium, and a second maximum in the cerite group, either at neodymium or samarium, according to the value adopted; the curve then descends to europium and subsequently rises somewhat steeply but regularly through gadolinum and terbium to a high maximum at dysprosium, after which it falls steeply and evenly through holmium, erbium, ytterbium, to lutetium. H. W.

Specific Heats of some Organic Liquids. ROBERT TRÉHIN (*Ann. Physique*, 1921, [ix], **15**, 246—263).—The liquid was heated

electrically in a Dewar vessel and the energy supplied measured. The rise in temperature was measured by a mercury thermometer. The Dewar vessel was immersed in a water-bath which was kept at the same temperature and the corrections for radiation thus eliminated. The results found, with an accuracy of 1 in 200, were: benzene $c = 0{\cdot}405 + 93 \times 10^{-5}(t - 15)$; toluene $c = 0{\cdot}410 + 107 \times 10^{-5}(t - 15)$; acetone $c = 0{\cdot}510 + 80 \times 10^{-5}(t - 15)$; chloroform $c = 0{\cdot}226 + 33 \times 10^{-5}(t - 15)$. In all cases c is the true specific heat; t the temperature. The effects of impurities are discussed.

J. R. P.

Molecular Heat of Hydrogen. F. H. MacDougall (*J. Amer. Chem. Soc.*, 1921, **43**, 23—28).—On the basis of Bohr's views with regard to the constitution of the hydrogen molecule, and on the assumption that the rotational energy corresponds with three degrees of freedom, the author has deduced formulæ by which the molecular heat of hydrogen may be calculated from the absolute zero up to 2600° abs. The results calculated by means of these formulæ are compared with the values put forward by Nernst (*Physikal. Zeitsch.*, 1912, **13**, 1064) and Pier (A., 1909, ii, 789; 1910, ii, 1031).

J. F. S.

Critical Temperature of Mercury. G. Meyer (*Physikal. Zeitsch.*, 1921, **33**, 76—78.)—The critical temperature of mercury has been calculated from measurements of the surface tension of mercury at 20° and 367° (Hagemann, *Diss. Freiburg i Br.*, 1914). From the measurements it is shown that the surface tension (α) against mercury vapour is represented by the formula $\alpha = 474{\cdot}7 - 0{\cdot}148t - 0{\cdot}000344t^2$ dyne/cm². Using this formula, the values of α, $\alpha(M/\rho)^{2/3}$, the molecular surface energy and $d/dt(\alpha[M/\rho]^{2/3})$ the temperature coefficient are calculated for every 20° from 20—360°. The number of double molecules is obtained, and it is shown that at 340° the value of the temperature coefficient is normal. Hence using the formula $d/dt(\alpha[yM/\rho]^{2/3} = -2{\cdot}121$, it follows that $\alpha(yM/\rho)^{2/3} = C - 2{\cdot}121t$ and for $t = 340°$ $y = 1$. Hence $C = 3125$. At the critical temperature $\alpha = 0$, hence $C = 2{\cdot}121t_k$ or $t_k = 1474°$. This value is compared with other values, with some of which it is in close agreement.

J. F. S.

Melting Point Apparatus. Fritz Friedrichs (*Zeit. angew. Chem.*, 1921, **34**, 61).—In a melting-point apparatus, the glass heating bath, surrounding the thermometer, is of oval section with flattened front and back, so that readings may be made microscopically without interference due to the curvature of the glass. The thermometer and melting-point tubes are, in addition, enclosed in an inner vessel of similar cross-section, which serves to overcome the thermometer lag; and for conveniently assembling the apparatus without removing the thermometer, the outer vessel is provided with oblique lateral tubular extensions through which, and through orifices in the inner vessel, the melting-point tubes are introduced near to the thermometer bulb.

W. J. W.

Piezoelectric Analysis. II. Investigation of Systems of which the Temperature of Solidification can pass through a Maximum. JEAN TIMMERMANS (*Bull. Acad. Roy. Belg.*, 1919, 753—766; from *Chem. Zentr.*, 1921, ii, 281. Compare A., 1914, ii, 109).—The author discusses the form of the piezometric curves for a pure substance the freezing point of which passes through a maximum with increasing pressure. Similar considerations are applied to mixtures of substances of this type. H. W.

Piezochemical Analysis. III. Crystallisation under Increased Pressure and its Relationship to the Mutual Solubility of Liquids. JEAN TIMMERMANS (*Bull. Acad. Roy. Belg.*, 1919, 767—785; from *Chem. Zentr.*, 1921, ii, 281. Compare preceding abstract).—The process of solidification of systems consisting of two liquid layers under high pressure is investigated theoretically and illustrated by many piezochemical curves. The original must be consulted for details. H. W.

The Lowering of the Vapour Pressure of Water at 20° Produced by Dissolved Potassium Chloride. B. F. LOVELACE, J. C. W. FRAZER, and V. B. SEASE (*J. Amer. Chem. Soc.*, 1920, **43**, 102—110).—The vapour pressure of solutions of potassium chloride of concentrations from 0·05*N* to 4·0*N* has been determined by the Frazer and Lovelace static method (A., 1915, ii, 11). The lowering of the vapour pressure and the molecular lowering are calculated and curves are constructed. The molecular lowering curve is found to be irregular at 20° and passes through a distinct minimum at the concentration *N*. The vapour pressures of potassium chloride solutions were calculated from freezing-point data by means of von Babo's law and an equation connecting freezing-point lowering with vapour pressure. The calculated values varied from about 3% greater than the observed values in the dilute solutions to about 6% less in the concentrated solutions. The percentage ionisation of dilute solutions of potassium chloride was calculated by comparing the vapour pressure lowerings with the lowerings produced by mannitol, and the values obtained agreed well with the best values from freezing point and conductivity data. J. F. S.

Vapour Pressures and the Isothermals of Vapours. J. H. SHAXBY (*Phil. Mag.*, 1921, [vi], **41**, 441—454).—Consideration of the internal pressure in fluids leads to the relation that in "ideal" substances the ratio of the occupied volume (covolume) to the total volume of the liquid is equal to the ratio of the unoccupied volume to the total volume of its saturated vapour. The two phases, in equilibrium with each other, are complementary in this respect. The equation $p = RT(d_1 + d_2)(d_2/d_1)^{(d_1+d_2)/(d_1-d_2)}$ is obtained for the saturation pressure of a vapour in terms of the temperature and the densities of the two phases at that temperature. This leads to a characteristic equation—

$$p[v - 1/(d_1 + d_2)] = RT(d_2/d_1)^{2/(d_1-d_2)v}.$$

It is shown that the quantity $d_1 + d_2$ may be regarded as a density factor which is a measure of the cohesive forces per unit mass. On this hypothesis modified forms of the above equations are obtained which express the experimental facts with considerable accuracy for all temperatures and pressures. Reduced forms of the vapour pressure equation are given as well as an equation for the calculation of the critical density of a substance. The values are consistent even with water, where the Mathias rule does not hold. J. R. P.

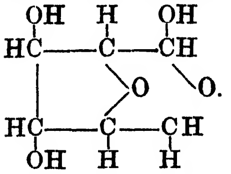
The Mechanism of the Exchanges of Energy in Vaporisation. René Audubert (*Compt. rend.*, 1921, **172**, 375—378).—The author deduces the equation $MJL = \alpha\pi d^2 N + RT$, where M is the molecular weight, J the mechanical equivalent of the calorie, L the latent heat of vaporisation, α the surface tension of the liquid, d the diameter of a molecule, and N Avogadro's number. From this he calculates for a number of liquids the value of d at two temperatures. The results agree with those obtained from the kinetic theory or from Bragg's work. Combining the above with Clapeyron's formula, an expression is obtained for the variation of vapour pressure with temperature, which is of the form obtained by Dupré and others. It is further shown that vaporisation is a discontinuous phenomenon, the elementary quantity of energy brought into action being $10 \times 10^{16} T_0$ ergs. Finally, the value obtained for K in $\alpha\pi N d^2 = K(T_c - T)$ is practically identical with that deduced from the law of Eötvös. W. G.

Determination of the Boiling Point of very Small Quantities of Substances. Victor Arreguine (*Ann. Chim. anal.*, 1921, [ii], **3**, 40—49).—The method proposed depends on the pressure of vaporisation and is similar to that described previously by Schleiermacher (A., 1891, 873). W. P. S.

Cottrell's Ebullioscopic Apparatus. James Frederick Spencer (*J. Amer. Chem. Soc.*, 1921, **43**, 301—302).—Modifications of the ebullioscopic apparatus described by Cotterell (A., 1919, ii, 447) and Read and Washburn (A., 1919, ii, 447) are suggested. These consist in replacing the two-limbed pump by a three-limbed pump, which will ensure a more uniform spraying of the thermometer bulb, and making both pump and condenser separate from the rest of the apparatus, which makes the apparatus less fragile and easier to clean. J. F. S.

The Chemical Constants. G. Heidhausen (*Zeitsch. Elektrochem.*, 1921, **27**, 69—72).—A theoretical paper in which the values of the chemical constants are calculated from Egerton's determinations of the vapour pressure of zinc and cadmium. The values calculated from Nernst's formula are, for zinc, — 1·62 and for cadmium, — 1·56. These results differ to some extent from those obtained by Egerton (A., 1920, ii, 84), but agree with the value, 1·59, calculated from the Sackur-Stern-Tetrode formula. E. H. R.

Calculation of the Heating Value from the Constitution of the Compound. F. Otto H. Binder (*Chem. Zeit.*, 1921, **45**, 141).—A method of calculating the heating value of a substance from its constitutional formula is given and illustrated in the case of cellulose, which is given the annexed constitutional formula.



Here 3 oxygen valencies are bound to hydrogen, and 6 oxygen valencies are bound to carbon, and a seventh oxygen valency, represented by the dotted line, may be regarded as bound to carbon. These valencies do not contribute to the heat effect on combustion. The calculation is effected thus: O_2 when it burns to carbon dioxide gives 96,960 cal., that is, 48,480 cal. per atom and 24,240 per valency, O_2 when it burns to water gives 68,920 cal. or 34,460 per valency. Cellulose contains 6 carbon atoms, which, on burning to carbon dioxide, give $6 \times 96,960 = 581,760$ cal., and the 10 hydrogen atoms give 344,600 cal., that is a total of 926,360, but from this $3 \times 34,460$ and $6 \times 24,240 = 145,440$ cal. must be subtracted, since this represents the heat effect of the valencies already bound. The total is therefore 677,540 cal. per gram-mol. or 4,182 cal. per gram, whilst the observed value is 4,189 cal. per gram. J. F. S.

Thermodynamic Treatment of Concentrated Solutions and Applications to Thallium Amalgams. Gilbert N. Lewis and Merle Randall (*J. Amer. Chem. Soc.*, 1921, **43**, 233—254).—A number of methods are developed for the thermodynamical treatment of concentrated solutions, and for the rapid and precise calculation of partial molecular quantities; these methods are applied to the data for thallium amalgams (Richards and Daniels, A., 1920, ii, 34, and Hildebrand and Eastman, A., 1916, ii, 14). It is shown how the heat of solution of solid thallium and supercooled liquid thallium in a large excess of mercury may be obtained, and how these quantities may be used for calculating the heat of fusion of thallium. The activities of thallium and mercury in amalgams of various compositions are given for 20° and 325°, and these values, resting on independent measurements, are compared by simple thermodynamic methods. The effect of temperature on the abnormality of solutions is discussed, and it is shown that the vapour pressure of amalgams at 325° may be calculated by two methods from the measurement of *E.M.F.* at 20°, between which two results the true value must lie. Thus in 40% amalgam the vapour pressure was found by one method to be 1% higher and by the other to be 2% lower than the calculated value. J. F. S.

Viscosity of Liquids. V. The Ideality of the System: Benzene–Benzyl Benzoate and the Validity of the Bingham Fluidity Formula. James Kendall and Kenneth Potter Monroe (*J. Amer. Chem. Soc.*, 1921, **43**, 115—125. Compare

A., 1920, ii, 670).—It has been claimed by Bingham and Sarver (A., 1920, ii, 737) that the system, benzene–benzyl benzoate is not ideal (perceptible contraction, presumably owing to solvation, occurring on mixing), and that consequently the conclusions of Kendall and Monroe (A., 1917, ii, 524) from their examination of the system are not valid, particularly their rejection of the fluidity–volume composition formula as the true ideal equation for binary liquid mixtures. An examination of Bingham and Sarver's experimental data, which are necessarily somewhat inaccurate owing to the impurity of the benzyl benzoate employed, shows that the contraction claimed is non-existent. Freezing point depression determinations also indicate the absence of compound formation. The system is, as previously asserted, essentially ideal. A critical investigation of the experimental and theoretical evidence for the validity of the linear fluidity–volume composition formula for ideal mixtures has not, in the author's opinion, disclosed any facts which warrant its reconsideration. The formula is systematically in error; other equations are known which are in far better agreement with fact, but the true ideal equation still remains to be discovered.

J. F. S.

Orientation of Molecules in Surfaces. VI. Cohesion, Adhesion, Tensile Strength, Tensile Energy, Negative Surface Energy, Interfacial Tension, and Molecular Attraction. WILLIAM D. HARKINS and Y. C. CHENG (*J. Amer. Chem. Soc.*, 1921, 35—53. Compare A., 1920, ii, 357).—Data are obtained whereby the total interfacial energy may be calculated for twelve organic liquids, and the work of adhesion and of surface cohesion, the interfacial tension and free surface energy, the tensile work, the energy of adhesion, of cohesion, and of surface cohesion, the tensile energy, the internal pressure or cohesion, and the related molecular attraction are discussed. The present data include two new and important relations, (i) that certain surface or interfaces between two liquids exhibit a negative surface energy, or, in other words, energy is set free when the surface is formed. This is just the opposite of previous results for all surfaces previously known, with the exception of the case when crystalline liquids are undergoing transformation, have required the expenditure of energy for their formation; (ii) whilst ordinary surfaces cool when they are expanded, these surfaces, and some others discovered in the present investigation, rise in temperature when they are formed. The liquids at the phase boundary of which with water a negative surface energy is exhibited are heptinene (with a triple bond at the end of the chain), *n* and *sec.*-octyl alcohol, and heptaldehyde. All the above liquids and a higher paraffin have a negative latent heat of the phase boundary, which indicates that the interface rises in temperature when it is expanded. The addition of one oxygen-atom to octane to give octyl alcohol increases the tensile energy by only 2%, whilst it increases the adhesional energy by 65%, and similar relations are found for the organic acids, aldehydes, and heptinene. In contrast with this, it is found that the double bonds increase the tensile

energy greatly, about 40%, in the change from hexane to benzene, whilst the adhesional energy towards water is increased only 30%. It is found also that the very symmetrical halogen derivatives, carbon tetrachloride, and ethylene dibromide, which give especially high values for their own tensile energy, give especially low values for their adhesional energy toward water. The tensile energy of ethylene dibromide, on account of its symmetry, is higher than that of ethylidene bromide. These facts are readily explained on the basis of the hypothesis that the unsymmetrical molecules are oriented in the surface, and therefore afford strong evidence in favour of the orientation hypothesis. When a bar of heptinene (or of an organic acid, alcohol, aldehyde or amine) is pulled apart, the break occurs where the electromagnetic field (largely electrical) and the resulting attraction are weakest, that is, between the hydrocarbon chains, and in order that this may be the case the hydrocarbon chains turn into the nascent surface in the process of its formation. In benzene, the symmetry of the molecules is so great that the break must occur between certain of the unsaturated groups, that is, where the intramolecular electromagnetic field is high. The fact that the adhesional energy of octane is so greatly increased by the addition of one oxygen atom to form octyl alcohol indicates that the oxygen atoms turn towards the water at their interface. Thus the adhesional energy toward water is determined by the strongest electro-magnetic fields in the molecule, while the tensile energy is determined by the weakest fields, provided the molecules are unsymmetrical. The solubilities of heptoic acid, heptinene, and heptaldehyde have been determined and are found to be nearly the same, which indicates that the length of the hydrocarbon chain is of more importance in determining the solubility than the nature of the active group at the end of the molecule, provided that the activity of the latter is not too widely varied. The triple bond in heptinene is found to increase the adhesional work from about 42 to 67, and the total adhesional energy from 105 to 147, the lower values being those for hexane. The introduction of one oxygen atom increases the adhesional work to 90, and the energy to 164. This indicates that the triple bond has a greater relative effect on the adhesional energy than on the adhesional work at 20° as compared with an hydroxyl oxygen atom. J. F. S.

Colour and Brownian Movement of Ultra-microscopic Metallic Particles. REINHOLD FÜRTH (*Physikal. Zeitsch.*, 1921, **33**, 80—87).—The colour and Brownian movement of gold and silver particles have been observed in a large number of cases in an ultra-microscope. From the observations the radii of the particles were calculated (i) by means of the Helmholtz theory, and (ii) by means of Einstein's theory. It is shown that between both series of results there is no systematic variation in the sense of $a_{Br} > a_F$ for gold or $a_{Br} < a_F$ for silver, where a_{Br} is the radius obtained from the Brownian movement and a_F that from the colour. J. F. S.

Augmented Adsorption. G. Wiegner, J. Magasanik, and A. J. Virtanen (*Kolloid Zeitsch.*, 1921, **28**, 51—76).—The adsorption of a series of saturated aliphatic acids from water and also from solutions of various concentrations of sodium chloride, potassium chloride, lithium chloride, ammonium chloride, calcium chloride, magnesium chloride, barium chloride, strontium chloride, and sodium sulphate by blood charcoal has been determined. The surface tension of all the solutions used for adsorption experiments was determined at ordinary temperatures. It is shown that the adsorption equilibrium between the fatty acids in aqueous solution and blood charcoal is displaced by the presence of neutral salts in the sense that more of the fatty acid is adsorbed than in pure aqueous solution. Double normal solutions of the salts mentioned above increase the amount of fatty acid adsorbed by blood charcoal. The augmentation of the adsorption of the fatty acids increases with decrease of the atomic weight of the kation for equivalent kations. The sulphanion augments the adsorption more than the chlorion at ordinary temperatures, but at the boiling point the relationship is reversed. The lowering of the surface tension of salt solutions of fatty acids compared with salt solutions is greater than that of fatty acid solutions compared with water. The lowering of the surface tension of the solution examined runs parallel with the amount of fatty acid adsorbed by charcoal. It is shown that the adsorption of fatty acids from aqueous solutions or from salt solutions by charcoal may be approximately calculated from the surface tension of these solutions. All the salts examined have a greater effect on the adsorption the greater the number of carbon atoms in the acid under investigation. The relationship between the concentration of the fatty acid in solution and that adsorbed by the charcoal is expressed by the formula $x/m = kc^{1/n}$, in which x/m represents the number of millimols. of acid adsorbed by 1 gram of charcoal, c is the equilibrium concentration of the acid in solution, and k and n are empirical constants. The lowering of the surface tension follows a similar exponential formula. With a constant salt concentration the value of k is greater than for pure aqueous solutions, the value of $1/n$ is also a little larger with salt solutions. The adsorption curves for low concentrations of fatty acids, both with and without addition of salts, are therefore approximately the same, but with increasing concentration of the fatty acids and with constant salt concentration the adsorption is increasingly augmented. The surface tension changes in the same sense. Addition of salt to a constant concentration of fatty acid increases the adsorption proportionally with the salt concentration. The increase of the surface tension of the neutral salt is, within defined concentrations, approximately proportional to the concentration of the salt, so that the lowering of the surface tension of a fatty acid of constant concentration as solvent by the addition of salt is increased by an amount proportional to the salt concentration. It is shown experimentally for the case fatty acid–salt solution that an augmentation of the adsorption can occur when one substance increases the surface tension, solution–

air, whilst the other lowers it. The adsorption augmentation of acetone, ethyl alcohol, and dextrose in aqueous solution by the presence of $2N$-sodium chloride has also been investigated.

J. F. S.

Comparative Experiments on the Adsorptive Capacity of Various Kinds of Charcoal. Is Wiechowski's Test Parallel to the Poison Fixation ? FRIEDRICH HORST (*Biochem. Zeitsch.*, 1921, **113**, 99—110).—Wiechowski's and Joachimoglu's methods (A., 1917, ii, 42) for the determination of the adsorptive capacity of charcoal is applicable to chemically defined poisons but not to toxins such as diphtheria, tetanus, and ricin toxins.

S. S. Z.

Study of Crystals by X-rays. FRANÇOIS CANAC (*Ann. Physique*, 1921, [ix], **15**, 153—246).—An account of the theory of the determination of crystal symmetry by the X-ray method. An apparatus for carrying out the determinations is described.

J. R. P.

Determination of the Structure of Crystals. RALPH W. G. WYCKOFF (*J. Franklin Inst.*, 1921, **191**, 199—230).—A brief survey of the work done on the structure of crystals by the X-ray method, with a discussion of some of the limitations of the latter.

J. R. P.

Application of the Theory of Space Groups to the Study of the Structure of Crystals. RALPH W. G. WYCKOFF (*Amer. J. Sci.*, 1921, [v], **1**, 127—137).—The paper is an attempt to present those details of the theory of space groups which are required in order that the results of the theory may be immediately applicable to the determination of the structure of crystals. The 230 possible space groups are obtained by arranging the 32 possible point groups in a regular pattern corresponding with one or other of the fourteen space lattices, of the same symmetry as the point group. The space grouping thus obtained can be divided into units of structure corresponding with the "crystal molecule," the dimensions of which are revealed by X-ray examination of a crystal. The X-ray spectrum measurements also indicate the number of chemical molecules contained in the crystal molecule. With the limitations imposed by the results thus obtained, the theory of space groups can be applied to determine the probable positions of the atom in the crystal molecule.

E. H. R.

Liquid Crystals. V. Photographic Absorption and Extinction Measurements. (MISS) RASSA RIWLIN (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 807—816. Compare A., 1919, ii, 101).—A photographic method is described for measuring the light absorption of any substance. The method was applied to p-azoxyanisole, and it was shown that in the visible spectrum, as in the infra-red region, the two liquid-crystalline phases, ex-solid and ex-liquid, have different absorptive powers.

E. H. R.

The Thermo-Electric Determination of Transition Points. A. SMITS and J. SPUYMAN (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 687—690).—When the *E.M.F.* of a thermocouple is plotted against temperature a smooth curve is generally obtained, but if one of the metals has a transition point within the temperature range considered, a discontinuity appears at the corresponding temperature. This phenomenon has been found to afford a rapid and accurate method for determining the transition temperature of tin. Using an iron–tin thermo-element, the transition temperature found was 200·2°. This agrees perfectly with the result obtained by the laborious dilatometric method, using mercury to accelerate the transformation of the tin. With a copper–tin thermo-element, very nearly the same result was obtained, 200·5°, but the break in the curve was not so sharp as with the iron–tin combination.

E. H. R.

The General Structure of Colloids. WOLFGANG PAULI (*Kolloid Zeitsch.*, 1921, **28**, 49—51).—A consideration of the physical-chemical analysis of ferric hydroxide sols shows that this substance is a complex salt of the type $x\,Fe(OH)_3\,y\,Fe/An$, where *An* is the anion in the presence of which the sol is formed. In the case of zirconyl chloride the following complex molecules have been identified: $Zr(OH)_4,Zr(OH)_4,ZrOCl_2,\overset{++}{ZrO} \mid \overset{--}{Cl_2}$;

$$Zr(OH)_4,ZrOCl_2,\overset{--}{ZrO} \mid \overset{++}{Cl_2};$$

$Zr(OH)_4,\overset{++}{ZrO} \mid \overset{--}{Cl_2}$ and $ZrOH_4,Zr(OH)_2Cl_2,\overset{--}{Cl_2} \mid \overset{++}{H_2}$. Similarly, molecules are found in the case of aluminium hydroxide sols. The question of the structure of metallic sols, such as gold sols, is considered, and it is shown here, also, that these sols are not composed of extremely small particles of the metals, but are complexes of the same type as those mentioned above.

J. F. S.

The Validity of the Law of Partition for the Equilibrium between a Mixed Crystal Phase and a Coexisting Liquid. A. SMITS (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 679—686).—Experiments were made to determine the distribution of dichlorobenzene and dibromobenzene (? para) in the system, dichlorobenzene–dibromobenzene–alcohol in the mixed crystal and liquid phases. On both the dichloro- and dibromo-benzene sides the partition law was found to hold when the concentration of one constituent was relatively small in comparison with that of the other, that is to say, the ratio of the concentrations in the liquid and solid phases respectively was constant. E. H. R.

Equilibrium Conditions of the Reaction between Manganate, Permanganate, and Manganese Dioxide. CHARLES E. RUBY (*J. Amer. Chem. Soc.*, 1921, **43**, 294—301).—The composition of equilibrium mixtures of potassium manganate and permanganate and the equilibrium constants have been determined at 45°; the equilibrium constant is given by the expression

$[MnO_4']^2[OH']^4/[MnO_4'']^3$ and has the value 53. The decrease in free energy accompanying the reaction $3K_2MnO_4 + 2H_2O = MnO_2(s) + 2KMnO_4 + 4KOH$, assuming that all the substances are completely ionised, is 10,500 joules and the *E.M.F.* of a cell in which it takes place is $+0.054$ volt. Regarding this *E.M.F.* as having the same value at 25° and combining it with the normal electrode potential (-0.61 volt) of $MnO_4'' + \oplus = MnO_4'$ (Sackur and Tagener, *Zeitsch. Elektrochem.*, 1915, **18**, 718), the following molecular electrode potentials are derived: $MnO_2(s) + 4OH' + 2\oplus = MnO_4'' + 2H_2O$, -0.664 volt; $MnO_2(s) + 4OH' + 3\oplus = MnO_4' + 2H_2O$, -0.647 volt; and $MnO_2(s) + 2H_2O + 3\oplus = MnO_4' + 4H^{\cdot}$, -1.757 volts. J. F. S.

The Equilibrium, Gelatin–Hydrochloric Acid. ROBERT WINTGEN and KARL KRÜGER (*Kolloid Zeitsch.*, 1921, **28**, 81—89).—The velocity of hydrolysis of methyl acetate by $0.05N$ and $0.10N$ hydrochloric acid in the presence of varying amounts of gelatin has been determined at 25°. The reaction mixtures were prepared as follows: 0, 0·1, 0·2, 0·5, 1·0, 2·0, 3·0, 4·0, and 5·0 grams of air-dried gelatin were placed respectively in a series of 100 c.c. flasks and dissolved at 70° in about 30 c.c. of water. After cooling to 25° in a thermostat, 50 c.c. of $0.1N$ or $0.2N$ hydrochloric acid were added, followed by 5 c.c. of methyl acetate, and the volume was made up to 100 c.c. The solution was titrated at periods up to 7,417 minutes. It is shown that the velocity constant decreases steadily with increasing gelatin content; thus for $0.05N$-hydrochloric acid the velocity constant R falls from 1.446×10^{-4} in the absence of gelatin to 0.052×10^{-4} for a content of 6 grams of gelatin per 100 c.c. With $0.1N$-hydrochloric acid the value of R falls from 2.850×10^{-4} in the absence of gelatin to 1.589×10^{-4} for a content of 5 grams of gelatin per 100 c.c. Making use of a slightly modified formula due to Sörensen (A., 1919, i, 175, 176, 177), the value of R is calculated on the assumption that one amino-group of the gelatin reacts with hydrochloric acid according to the equation $[Ge]NH_2 + HCl = [Ge]NH_3Cl$, so that in aqueous solution the equilibrium $[Ge]NH_3Cl + H_2O \rightleftarrows [Ge]NH_3{\cdot}OH + HCl$ is established, and it is found that the experimental values are always a little greater than the calculated values. The hydrogen-ion concentration has also been determined and calculated, and here a satisfactory agreement is obtained. The molecular weight of gelatin is deduced from the experimental data as 1,014 and K, the hydrolysis constant of the gelatin hydrochloride, as 4.139×10^{-4}, and from this the basic hydrolysis constant $k_b = k_w/K = 2.7 \times 10^{-11}$, where k_w is the ionic product of water. J. F. S.

The Displacement of Metals in Saline Solutions. BARLOT (*Compt. rend.*, 1921, **172**, 378—381).—The precipitation of one metal from a solution of one of its salts by another more electronegative metal, such as the precipitation of copper by zinc, may most readily be followed by soaking a piece of filter paper in a solution of a copper salt, placing it on a glass plate, and then placing a

fragment of zinc on the paper. It is shown that the copper crystallises out radially from the zinc, the lines of crystals not crossing. If two or more fragments of zinc, not touching, are used, there is apparently a neutral zone between the fragments, which the copper crystals do not cross. W. G.

The Double Saline Decompositions and their Geometric Representation. HENRY LE CHATELIER (*Compt. rend.*, 1921, **172**, 345—350).—A diagram is figured and described by means of which it is possible to solve the following problems: (1) the determination of the mixtures of three salts having a composition identical with that of the mixture considered; (2) the determination of the surface of saturation; (3) following the progress of crystallisation, and determining the quantity of salt deposited; (4) the conditions under which there is re-solution of one of the salts at the invariant point. The problem is illustrated by reference to the double decomposition,

$$NaNO_3 + NH_4Cl = NH_4\cdot NO_3 + NaCl.$$

W. G.

Theory of Unimolecular Reactions. RICHARD C. TOLMAN (*J. Amer. Chem. Soc.*, 1921, **43**, 269—274).—A theoretical paper. The dependence of the specific reaction rate on temperature in dilute homogeneous systems can be fairly satisfactorily represented by the expression $k = se^{-Q/RT}$. The significance of Q and s is differently interpreted by different authors (Lewis, T., 1918, **113**, 471, and others). The true significance of these quantities is discussed in the present paper. J. F. S.

Phenomena of the Ignition of Gaseous Mixtures by Induction Coil Sparks. JOHN DAVID MORGAN and RICHARD VERNON WHEELER (T., 1921, **119**, 239—251).

Oxidation and Luminescence of Phosphorus. I. HARRY B. WEISER and ALLEN GARRISON (*J. Physical Chem.*, 1921, **25**, 61—81).—It is assumed that when phosphorus vapour and oxygen are brought in contact the reaction proceeds with a velocity given by $V = kC_P^x . C_O^y$, where C_P and C_O are the concentrations of phosphorus vapour and oxygen. C_P is constant in contact with the solid, hence the velocity of oxidation is $V = k_1C_O^y$. Below 25° and above a certain partial pressure of oxygen, this is no longer valid, owing to the formation of an oxide film on the surface of the phosphorus. If the oxygen pressure is great enough, the reaction is forced to the surface of the solid phosphorus, which becomes covered with the oxide film. The film is destroyed by decreasing the partial pressure of the oxygen below a limiting value or by increasing the rate of volatilisation of the phosphorus. The limiting pressure, above which a protecting film is produced, is not constant, since any factor which diminishes the oxygen concentration or rate of diffusion, or increases the phosphorus vapour pressure or rate of diffusion, will increase the limiting pressure. The intermittent luminescence in the narrow critical region between the limiting

pressure and the glow pressure may be due to the periodic breaking down and re-formation of the oxide film. J. R. P.

Motion of Sound in Partly Dissociated Gases. A. EINSTEIN (*Sitzungsber. Preuss. Akad. Wiss. Berlin*, 1920, 380—385).—The theory of the motion of sound in a partly dissociated diatomic gas is examined. The velocity of sound depends on the constants of the velocity of reaction, and the latter may be determined from the velocity of sound in the gas. J. R. P.

Thermal Decomposition of Gaseous Nitrogen Pentoxide: a Unimolecular Reaction. FARRINGTON DANIELS and ELMER H. JOHNSTON (*J. Amer. Chem. Soc.*, 1921, **43**, 53—71).—The velocity of decomposition of gaseous nitrogen pentoxide has been determined at temperatures from 0—65°, using an all-glass apparatus. The manometer used has been previously described (A., 1920, ii, 485) as has also the method of preparing pure nitrogen pentoxide. The decomposition at all temperatures is shown to be unimolecular. The velocity constant has the following values at the different temperatures: 65°, 0·292; 55°, 0·0900; 45°, 0·0299; 35°, 0·00808; 25°, 0·00203; 25° (with solid present), 0·00191; 20°, 0·00117; 15° 0·000624; and 0°, 0·0000472. The large temperature coefficient of the reaction velocity showed that catalysis by the glass walls and diffusion was not a factor in the reaction; furthermore, the addition of glass wool with a large surface caused no change in the rate of reaction. The amount of nitrogen pentoxide taken was calculated from the pressure after complete decomposition. The results were corrected for the dissociation $N_2O_4 \rightleftarrows 2NO_2$ so that the system studied was

$$2N_2O_5 \rightarrow \underset{\substack{\uparrow\downarrow \\ 4NO_2}}{2N_2O_4} + O_2.$$

The critical increment E has been calculated and found to be independent of the temperature; it has the value 24,700 cals. J. F. S.

Photochemical Decomposition of Nitrogen Pentoxide. FARRINGTON DANIELS and ELMER H. JOHNSTON (*J. Amer. Chem. Soc.*, 1921, **43**, 72—81. Compare preceding abstract).—The photochemical decomposition of nitrogen pentoxide has been investigated at 0°. It is shown that the black body radiation from the vessel walls at 0° causes a reaction which is negligible in comparison with that produced by radiation received from a body emitting white light and not in equilibrium with the system. Calculations from the reaction velocity constants at different temperatures give 24,700 cals. for the critical increment, E. From the expression $E = Nh\nu$, λ is found to be $1{\cdot}16\mu$, which, according to the hypotheses of Perrin (A., 1919, ii, 177) and Lewis (T., 1918, **113**, 471), should be photochemically active in this case. It is shown, however, that light of this wave-length does not decompose nitrogen pentoxide within the limits of the present observations. Light in the region 400—460$\mu\mu$ accelerates the decomposition of nitrogen pentoxide, but this decomposition does not take place

unless the dioxide is present. The autocatalytic effect of nitrogen dioxide is negligible in the dark. Hypotheses to explain these facts are put forward, and their relation to theories connecting chemical action with radiant energy is suggested. J. F. S.

Law of Probability Applied to the Formation of Fats from Carbohydrates. EDGAR J. WITZEMANN (*J. Physical Chem.*, 1921, **25**, 55—60).—If the relative abundance of occurrence of the various fatty acids in plants is plotted against the number of carbon atoms, and the prominences corresponding with C_{12}, C_{24}, etc., are connected, a smooth curve symmetrical about the maximum ordinate corresponding with C_{18} is obtained, which has the form of the typical probability curve. This is said to support the hypothesis that the fatty acids are formed from carbohydrates containing chains of six carbon atoms. Three molecules of the latter, for example, are joined through their aldehyde groups, and by transposition and removal of oxygen from the resulting molecule a fatty acid containing C_{18} is formed. The less frequent occurrence of intermediate acids containing C_{10}, C_{14}, etc., may be due to their formation from higher unsaturated acids by loss of two or more carbon atoms, or by synthesis from short carbon chains. J. R. P.

The Activity of Water in Sucrose Solutions. W. E. GARNER and IRVINE MASSON (*Phil. Mag.*, [vi], 1921, **41**, 484—486).—The results of Jones and Lewis (T., 1920, **117**, 1125) are explained on the assumption that the increase of activity of the hydrogen ion is due to a virtual increase in the concentration of the sulphuric acid due to the inactivating effect of sucrose molecules on water molecules. This effect may consist in hydration of the sucrose, and in this case there would be an actual increase in the hydrion concentration in the free water. The water which is thus fixed by the sugar (changing from $10H_2O$ to $5H_2O$ per sucrose molecule) is not available as a solvent for the hydrogen ion or for gases, nor is it osmotically active. From the data of Jones and Lewis it appears that this water is nevertheless chemically active, since the rate of inversion is proportional to the total water present, and not merely to the free water—a fact which is said to be difficult to explain on any supposition other than the above. J. R. P.

Catalytic Decomposition of Hydrogen Peroxide by Ferric Salts. VAN L. BOHNSON (*J. Physical Chem.*, 1921, **25**, 19—54).—Ferric salts accelerate the decomposition of hydrogen peroxide to a greater degree than sodium iodide in equivalent concentration. With dilute solutions of ferric chloride and nitrate the effect is proportional to the concentration; ferric sulphate is less active. The catalytic effect is explained by the intermediate formation of ferric acid: (1) $2FeR_3 + 3H_2O_2 + 2H_2O \rightleftharpoons 2H_2FeO_4 + 6HR$; (2) $2H_2FeO_4 + 3H_2O_2 \rightleftharpoons 2Fe(OH)_3 + 2H_2O + 3O_2$; (3) $2Fe(OH)_3 + 6HR \rightleftharpoons 2FeR_3 + 6H_2O$, in which (2) is a measurable reaction. Constants were obtained for the unimolecular reaction. The specific reaction velocity decreases as the reaction proceeds, owing to hydrolysis of the catalyst. Colloidal ferric hydroxide or

basic salts have no catalytic effect. Addition of acid retards the reaction, apparently by reducing the concentration of the intermediate product. Salts having an ion in common with the catalyst retard the decomposition by decreasing the dissociation of the catalyst. Mercuric chloride has very little influence; sodium sulphate, acetate, and formate delay the reaction, apparently owing to hydrolysis of the resulting ferric salts. A mixture of ferric sulphate with ferric chloride or nitrate does not accelerate the reaction to so great an extent as would be indicated by the sum of the separate effects. Cupric sulphate accelerates the action of ferric sulphate. Alcohol, which is oxidised by the ferric salt, acts anti-catalytically owing to the formation of acetic acid. Glycerol, sucrose, gelatin, carbamide, and acetamide also act anti-catalytically.

J. R. P.

The Catalytic Decomposition of Hydrogen Peroxide by Electrosols and Electrogels of Platinum. ANTONIO DE GREGORIO Y ROCASOLANO (*Anal. Fís. Quím.*, 1920, **18**, 361—367).—The author criticises the hypothesis of Bredig that the catalytic decomposition of hydrogen peroxide is unimolecular. Using electrosols of platinum of varying concentrations (0·001—0·003%), the decomposition has been followed over periods up to 10,080 minutes. It is shown that, applying the results obtained to the usual formula $K = 1/t \log a/a - x$, the values of K show a steady diminution with increasing time.

Applying the results to a modified formula used elsewhere in studying the catalytic decomposition of hydrogen peroxide by hæmase, the values of K showed a similar lack of constancy.

Plotting the values of K obtained against the time, it is shown that in the later stages the curve becomes almost parallel to the time axis. In other words, the value of K reaches a constant, and the reaction becomes unimolecular.

In order to confirm this, the corresponding platinum gels, obtained by drying the sols at the ordinary temperature, were used as catalysts. In all cases the reactions were found to be truly unimolecular. This was also the case where fresh hydrogen peroxide was added after the reaction had reached the unimolecular stage.

It is supposed that the disperse phases of electrosols of platinum consist of solid solutions of oxygen in platinum. The catalytic activity of a sol is proportional to the oxygen concentration in the disperse phase. This concentration of oxygen diminishes as the reaction proceeds, and reaches a minimum in the later stages when the reaction becomes unimolecular. G. W. R.

Influence of Mercury, Sulphur, Arsenic, and Zinc on the Catalytic Activity of Platinum. EDWARD BRADFORD MAXTED (T., 1921, **119**, 225—233).

Periodic System, Atomic Structure, and Radioactivity. FRANZ URBACH (*Physikal. Zeitsch.*, 1921, **22**, 114—119).—A conception of the atomic structure, based on the relationships apparent from the periodic system, is put forward. This idea leads to an

explanation of the many regularities of the periodic system. A consideration of the phenomena of radioactive disintegration in connexion with the Kossel valency hypothesis (A., 1916, ii, 243) leads to an interpretation of other radioactive phenomena, and to an explanation of the eighth group of the periodic system and to a possibility of explaining the existence of the elements of the rare earths. J. F. S.

The Structure of the Molecule and Chemical Combination. (SIR) J. J. THOMSON (*Phil. Mag*, 1921, [vi], **41**, 510—544).—It is assumed (cf. *Phil. Mag.*, April, 1919) that in the atom the electrons are in equilibrium under their mutual repulsions and the attractions exerted upon them by the positive charges. The repulsions between electrons are supposed to follow the inverse square law, but the force between the electron and the positive charge is more complicated and varies with the distance r according to a law $F(c/r)$ where c is a length. When r is very large or very small compared with c, $F(c/r)$ reduces to $1/r^2$, but when r is comparable with c the force is no longer of simple type, but vanishes at certain distances, changing from attraction to repulsion, or vice versa. This arrangement is preferred to electrons describing orbits under forces varying as the inverse square law, because in the latter each electron must have a separate and isolated orbit if the system is to be stable and the model becomes too complicated to be of assistance. The scattering of light is also not in accordance with electrons describing orbits.

The arrangement of electrons around the central positive charge is next considered. If there is only one electron it must be at one of the places where the force exerted by the central charge vanishes, and the condition of stability requires that the force must become attractive when the electron is displaced away from the centre and repulsive when it is displaced towards the centre. The condition of equilibrium for two electrons is that they shall be situated so that the centre is midway between them, and the repulsion between them is equal to the attraction exerted by the centre on either. Three electrons arrange themselves at the corners of an equilateral triangle, four at the corners of a regular tetrahedron, and so on. The electrons are on the surface of a sphere with the positive charge at the centre. For any number of electrons, these must be symmetrically placed so that the force exerted on any electron by any other is along the radius and its magnitude the same for all. This equilibrium will not be stable unless another condition is satisfied, and the limitation thus imposed determines the structure of the atom or molecule. It is that the attraction due to the central charge is greater than the repulsion due to other electrons when, one electron is displaced outwards by a small distance from its equilibrium position. It is shown in this way that, although there may be equilibrium positions with large numbers of electrons if the central charge is proportional to the number of electrons, the condition of stability is satisfied only by a limited number of electrons, provided that the central charge

is not to exceed the sum of the charges on the electrons. If the law of force is $F(c/r) = E(1 - c/r)/r^2$, where E is the central charge, this maximum number of electrons is eight, independent of c, if the electrons are at the corners of a regular polyhedron. It is five if the electrons are in a ring.

The cube is not the stable arrangement of eight electrons; this is a twisted polyhedron with eight triangular faces and two four-sided ones. Two such polyhedra may be placed in contact so as to have two, three, or four corners in common. When there are more than eight electrons on the surface of a sphere the positive charge at the centre becomes greater than the charges on the electrons, and this governs the structures of atoms and molecules, which must be electrically neutral.

Atoms may therefore exist with from one to eight electrons on the surface of a sphere surrounding a positive charge equal to the sum of the charges on the electrons. If the central charge is nine, eight electrons will form a spherical shell concentric with the central charge, and one electron will go outside to find a position of stable equilibrium. The external layer of this atom will contain one electron, and in this respect will resemble the atom with unit positive charge and one electron. If the atom contains ten electrons there will be two outside the shell, and so on. When the number of electrons outside the first shell becomes eight they compose a second complete shell, and so on. There will be a periodicity of the number of electrons in the outer shell, this rising from one to eight, then dropping to one again, and so on. So far as properties depending on the outer layer are concerned, the elements will exhibit periodicity similar to that expressed in the periodic law.

The number of elements included in a period may be greater than eight, in the case of elements of high atomic weight. The addition of one unit to the positive nuclear charge may lead to one additional electron leaving the outer shell and entering a shell of the innermost layer. The two atoms will have different atomic weights and different central charges, but equal numbers of electrons in the outer layers, so that their properties which depend on the outer layer (presumably including valency) will be common. When there are a great number of electrons in many layers it may require the addition of several electrons before a new electron finds its way to the outer layer, and there may be a considerable number of elements with different atomic weights, but very similar chemical properties, such as the transitional elements and the elements of the rare earths. The number of electrons in the outer layer is supposed to be equal to the number of the group in which the element occurs in the periodic table.

It is shown that an atom with seven electrons in the outer shell, such as fluorine, may have the same valency as an atom with only one, such as sodium, and that an atom may possess two valencies, the sum being always equal to eight. The existence of active valencies of seven in alkali metals is, however, not probable on the theory. The freedom of motion of the electrons is of importance in connexion with the attraction which the atom is likely to experience

from other atoms. A mobile electron will move round to face a positive atom.

The distance of the outer ring of electrons from the centre of the atom is shown to diminish in atoms of a period from that of least to that of greatest atomic weight. It increases again abruptly when a new period begins, only to fall throughout the period. This differs from Lothar Meyer's generalisation, in which the minimum atomic volumes came at the middle of the periods, but is in agreement with the results of W. L. Bragg (A., 1920, ii, 537).

Molecules are assumed to be formed by the electrons of the atoms acting as couplings; each unit valency bond requires two electrons, one belonging to each atom. A double bond is represented by four electrons arranged at the corners of a square at right angles to the line joining the atomic centres. More complicated cases are discussed. Molecules may have transitory existence which violate the ordinary principles of valency, for example, CNe, NF, NOH_2, etc. The molecules which survive are those showing the smallest tendency to attract other molecules—"the law of survival of the unattractive."

The similarity in physical properties of carbon monoxide and nitrogen is referred to, and a distinction drawn between carbon monoxide and the carbonyl radicle. In the latter two of the four electrons of the carbon atom unite it to the oxygen, making up with the six electrons of the latter an eight-electron cell around the oxygen, leaving two electrons free. The benzene molecule may be represented as composed of six cells and thirty electrons. The cells may be in contact round a ring with threefold contact between each two. As the opposite triangular faces of the twisted cell which is the stable configuration for eight electrons are inclined, this packing could be done without introducing much strain, and the result would be a completely symmetrical structure representing the so-called "centric formula." A representation of the Kekulé formula is also possible; three sets of pairs of cells are taken, the cells in one pair having fourfold contact with each other, but only double contact with a cell of a neighbouring pair.

The evidence from positive rays is discussed in detail, and the existence of charged atoms and molecules and the magnitudes of the charges are shown to be in agreement with the theory.

The configuration of the molecule may be inferred from the scattering of light. The light scattered from an electron or a perfectly symmetrical body, such as a spherical molecule, is completely polarised in a direction at right angles to the incident beam. That scattered from an imperfectly symmetrical body is not completely polarised, and the ratio of the minimum to the maximum intensity as seen through a Nicol may be taken as an indication of the deviation of the scattering body from sphericity. In this way it is shown that the symmetry decreases from argon to nitrogen, abruptly to oxygen, and again abruptly to carbon dioxide and nitrous oxide. The nitrogen molecule appears to contain only one cell, the oxygen molecule two, and carbon dioxide and nitrous oxide three cells. Other properties are discussed. J. R. P.

Theory of Auxiliary Valencies and Water of Crystallisation. H. T. F. RHODES (*Chem. News*, 1921, **122**, 85—87, 97—99).—A theoretical discussion of the constitution of crystal hydrates. After a discussion of Werner's co-ordination hypothesis, the author proposes ring structures for the molecules of salts with water of crystallisation which are similar to those for complex salts put forward by Friend (T., 1908, **93**, 1006).—An examination of a list of crystalline hydrates shows that 4% have $1H_2O$ of crystallisation, 6%, $2H_2O$, 8%, $3H_2O$, 16% 4 and $8H_2O$, 19%, 5 and $10H_2O$, 38%, 6, 7, and $12H_2O$; 4%, $9H_2O$; 2%, $15H_2O$, and 3%, $18H_2O$.

J. F. S.

Application of the Law of Hydrolysis to the Determination of Molecular Weights. H. COLIN and (MLLE) A. CHAUDUN (*Compt. rend.*, 1921, **172**, 278—280).—From a study of the hydrolysis of sucrose, raffinose, and gentianose by sucrase it is shown that if a group of substances of molecular weights, M_1, M_2, M_3 . . . M_n, are all hydrolysed in an identical manner by the same ferment, and the weights of these different substances capable of fixing equal quantities of enzyme are given by a_1, a_2, a_3 . . . a_n, then

$$a_1/M_1 = a_2/M_2 = a_3/M_3 = \ldots = a_n/M_n.$$

W. G.

Glass Autoclave. SCHMIDT (*Zeitsch. angew. Chem.*, 1921, **34**, 37).—An autoclave constructed entirely of glass is mentioned which may be used for pressures up to 4 atmospheres. The construction appears from a drawing to be similar to that of the ordinary metal autoclave. The apparatus is fitted with a valve which must be moistened with liquid paraffin, and a tap is attached whereby gas (carbon dioxide or nitrogen) under pressure may be admitted.

J. F. S.

An Automatic Syphon. C. J. PELLE (*Chem. Weekblad*, 1921, **18**, 127).—This device, due to P. H. Bon, consists in fusing to the end, *a*, of one limb of an ordinary syphon tube a considerably wider concentric tube, *b*. The lower end of *b* is closed or sealed except for an opening much smaller than the diameter of *a*. A small opening, *c*, is made in the inner tube, *a*, just below the point at which *b* is fused on. When the limb is plunged into fluid, the latter ascends in *a* much more quickly than in *b*, since the opening in the latter is so small, and closes the opening, *c*, so that air is enclosed in *b* under pressure, and assists the liquid to rise in *a*.

S. I. L.

Inorganic Chemistry.

The Rectilinear Diameter of Hydrogen. E. MATHIAS, C. A. CROMMELIN, and H. KAMERLINGH ONNES (*Compt. rend.*, 1921, **172**, 261—263).—The authors have determined the density curves of hydrogen for the liquid and the saturated vapour at the same temperatures between the critical point, $-239·91°$, and the b. p., $-252·66°$. The ordinate of the diameter is given by $y = -0·063510 - 0·00039402\theta$. The angular coefficient of the diameter is $d = -0·00039402$. The formula of the diameter gives for the critical density at $-239·91°$ $\Delta = 0·03$, the critical coefficient being $R\Theta\Delta/\pi = 3·276$. The deviations of the diameter are for the most part small, and show that hydrogen obeys the law of the rectilinear diameter. W. G.

Some Properties of Selenium Oxychloride. VICTOR LENHER (*J. Amer. Chem. Soc.*, 1921, **43**, 29—35).—A number of the properties of selenium oxychloride ($SeOCl_2$) have been investigated. It is a nearly colourless liquid, b. p. 176·4° at 726 mm., m p. 8·5°, refractive index at 20°, 1·6516, specific conductivity $9·6 \times 10^{-4}$ at 28°. It absorbs all light up to $\lambda = 4050\mu\mu$, and is completely miscible with carbon tetrachloride, chloroform, carbon disulphide, and benzene, no chemical action taking place in any case. Saturated aliphatic hydrocarbons are immiscible with selenium oxychloride at the ordinary temperature, but when a mixture of the higher paraffins (vaselin) and selenium oxychloride are heated to 150—160° complete miscibility is obtained. Sulphur, selenium, and tellurium dissolve in cold selenium oxychloride, but when heated, reactions take place, in the case of sulphur the products are selenium monochloride, sulphur monochloride, and sulphur dioxide, tellurium is converted into the tetrachloride. Red phosphorus attacks cold selenium oxychloride with development of heat and light. whilst yellow phosphorus reacts explosively. Bromine and iodine dissolve in selenium oxychloride to produce very active solutions, which are coloured reddish-brown and violet respectively. Boron, silicon, and carbon are not attacked by the oxychloride. Most of the metals react with the oxychloride to form the chloride of the metal and selenium monochloride, thus aluminium, zinc, bismuth, and tin react readily, calcium, copper, magnesium, chromium, lead, nickel, arsenic, cadmium, cobalt, gold, and platinum are slowly attacked, potassium reacts explosively, whilst sodium is not affected by the oxychloride even when it is distilled over the metal. Iron reacts slowly with the cold oxychloride, but the reaction is accelerated on heating, titanium is only acted on at high temperatures, and there is no action with tungsten. Selenium oxychloride dissolves selenium dioxide, arsenic trioxide, vanadium pentoxide, and molybdenum trioxide; in the last three cases a reaction takes place. A reversible photochemical reaction occurs with the solution of molybdenum trioxide; in bright light the solution becomes indigo-blue in a few minutes,

and this when kept in subdued light fades to pale yellow in a few hours. The oxides of aluminium, thorium, the rare earths, titanium, zirconium, niobium, and tantalum are not attacked, but uranium oxide is slowly attacked at ordinary temperatures. Tellurium is dissolved, but may be regained by distilling the solvent. Sulphur trioxide dissolves in the oxychloride to form a thick, heavy solution, which is a powerful solvent. This mixture will dissolve the oxides of aluminium, chromium, the rare earths, titanium, niobium, molybdenum, vanadium, and uranium, but will not dissolve the oxides of zirconium or tungsten, and dissolves tantalum oxide but slightly. The reactions of selenium oxychloride with a number of carbonates, sulphides, carbides, and other compounds are described. It is remarkable that calcium hydride, carbide, and phosphide do not react with cold selenium oxychloride, but the two latter compounds react slowly on boiling. Barium sulphate is peptised by selenium oxychloride, a gel is formed much like aluminium hydroxide, which is changed to the ordinary form by treatment with water. Chromium trioxide or potassium dichromate dissolves in selenium oxychloride to form a red solution, which on heating evolves chromyl chloride. Saturated aliphatic hydrocarbons are only slowly attacked even on heating, whilst unsaturated aliphatic hydrocarbons and terpenes react violently with the oxychloride. Benzene hydrocarbons form physical mixtures. Protein materials, such as hair, silk, and leather, dissolve in the cold oxychloride, but cellulose is neither dissolved nor attacked. Vegetable and fish oils are acted on much in the same way as by sulphur monochloride; with linseed oil a rubber-like mass is produced. Menhaden oil reacts with selenium oxychloride to form a waterproof rubber-like mass. Pure rubber, vulcanised rubber, and vulcanite are all chemically attacked by the oxychloride. Gums, resins, shellac, dried paints, lacquer, agar, celluloid, gelatin, and glue are dissolved by cold selenium oxychloride. Natural asphalts, resins, and bitumens dissolve with ease in selenium oxychloride in the cold when they are unsaturated, but substances like ozokerite behave like the paraffins. With coal and carbon selenium oxychloride extracts the bituminous and resinous materials, and leaves a carbonaceous residue. In handling selenium oxychloride the same care is used as with any other corrosive liquid; it has no other physiological action beyond that of the action of the hydrochloric acid produced when its vapours are hydrolysed in contact with the mucous membrane. J. F. S.

The System, Iodine-Tellurium. Study of the Vaporisation. A. DAMIENS (*Compt. rend.*, 1921, **172**, 447—450).—A study of the vaporisation of different mixtures of iodine and tellurium tetraiodide in a vacuum confirms the results previously obtained from a thermal study of the system, iodine-tellurium (this vol., ii, 110). W. G.

Photoelectric Photometry of the Luminosity of Active Nitrogen. E. VON ANGERER (*Physikal. Zeitsch.*, 1921, **22**, 97—102).—A method is described whereby by means of a photo-

electric cell, a variable feeble light intensity may be measured from second to second. It is shown that the lag of the photoelectric cell is so slight that for such purposes it may be neglected. The arrangement described has been used to determine the rate at which the luminosity of active nitrogen disappears. A glass globe 47 cm. diameter was filled at a suitable pressure with chemically pure nitrogen and used as an electrodeless tube. After the current was broken it was found that the bulb glowed for two and a half minutes when strongly excited, and in any case it was possible to read a watch for fifteen seconds after the current was switched off. It is shown that the reciprocal of the light intensity is practically proportional to time which has elapsed from the breaking of the exciting circuit, which implies that the reaction accompanying the luminosity is bimolecular. J. F. S.

Demonstration of the After-glow of Active Nitrogen by Means of an Electrodeless Ring Current. J. ZENNECK (*Physikal. Zeitsch.*, 1921, **22**, 102—103. Compare preceding abstract).—An electrodeless globe 46·5 cm. diameter and filled with chemically pure nitrogen is encircled by a simple wire circuit 47·5 cm. long, which is connected with four large Leyden jars and a spark gap. The system is fed by a Boas resonance induction apparatus for fifty-period alternating current. Using such an arrangement, the after-glow is visible for about thirty seconds. The glow is very intense and of an orange-yellow colour at first, which slowly changes to a greenish-yellow colour. J. F. S.

The Actual State of the Synthesis of Ammonia by Hyperpressures. GEORGES CLAUDE (*Compt. rend.*, 1921, **172**, 442—444. Compare A., 1920, ii, 30, 173).—The apparatus previously described (*loc. cit.*) is modified so as to carry out the compression of the mixed gases in one stage and materially to increase the yield. W. G.

The Fusion of Carbon. EUGEN RYSCHKEWITSCH (*Zeitsch. Elektrochem.*, 1921, **27**, 57—64).—The carbon electrodes of a resistance furnace, after a run of from eight to twelve hours, showed unquestionable signs of having partly melted at the points of contact with the graphite which served as the resistance of the furnace. At the end of the run both the resistance material and the electrode ends were practically pure graphite, containing 99·9% of carbon. The results of other investigators on the fusibility of carbon, Moissan, Despretz, La Rosa, and Lummer, are discussed. [Compare *J. Soc. Chem. Ind.*, 1921, 178A.]
E. H. R.

Topochemical Reactions. Formation of Carbon at Contact Substances. V. KOHLSCHÜTTER and A. NÄGELI (*Helv. Chim. Acta*, 1921, **4**, 45—76. Compare A., 1919, ii, 151, 152, 156).—The authors have investigated the nature of the carbon deposited when carbon monoxide is passed through a tube containing a metallic accelerator heated at 500° (compare Gruner,

A., 1871, 798; Schenck and Zimmermann, A., 1903, ii, 423; Schenck and Heller, A., 1905, ii, 519, 526; Smits, A., 1906, ii, 71). The accelerators employed comprised powdered nickel and cobalt, powdered and reduced iron, electrolytic nickel, nickel filings, rolled metallic foil, and both smooth and rough electrolytic deposits of various metals.

The structure of the carbon separated is found to be influenced by the character of the contact metal, the temperature of the reaction, and the state of subdivision of the accelerator. Cobalt yields a graphitic carbon of markedly different nature from that obtained with iron or nickel; the similarity of the results obtained with electrolytic and powdered cobalt indicates a specific action of the metal. Neither with reduced nor with powdered iron is the formation of graphite favoured by raising the temperature of the reaction; increase in the degree of subdivision of this metal does, however, favour the development of the graphitic type.

In comparison with the carbon of electrolytic deposits which exhibits strongly graphitic properties, that deposited on powders, with the exception of powdered cobalt, more nearly resembles soot in appearance and behaviour. The view that a continuous gradation exists between the different forms of carbon is thus supported, and it is further evident that, under similar external conditions, the formation of one or another product may be obtained from one and the same chemical reaction merely by alteration of the structure of the locality of the reaction. T. H. P.

The Combustion of Carbon in the Presence of Oxides. E. Berger and L. Delmas (*Bull. Soc. chim.*, 1921, [iv], **29**, 68—77).—An examination of the behaviour of two types of carbon, when intimately mixed with small amounts, not exceeding 4%, of different metallic oxides, and heated to their ignition points. A certain number of these oxides facilitate the combustion of the carbon in air. A certain number of other oxides cause a diminution in the proportion of carbon monoxide produced in the combustion of the carbon alone. Among the most active are those which are known as good catalysts for various oxidation processes.

W. G.

Absorption of Carbon Monoxide by Cuprous Ammonium Carbonate Solutions. Wm. R. Hainsworth and E. Y. Titus (*J. Amer. Chem. Soc.*, 1921, **43**, 1—11).—The volume of carbon monoxide absorbed by stated volumes of cuprous ammonium carbonate solution has been determined for various concentrations of the solution at temperatures, 1°, 11°, 40°, 50°, and 60°, and at various pressures. The absorption capacity of a solution having a given cuprous content is dependent on the free ammonia content of the solution and the partial pressure of the carbon monoxide above it, as well as the concentration of the cuprous copper. Under the experimental conditions the absorption takes place with the formation of an unstable compound which probably contains one molecule of carbon monoxide to each gram-atom of cuprous copper. $Cu_2(NH_3)_{2n}CO_3 + 2CO + 4H_2O = Cu_2(NH_3)_{2n}CO_3,2CO,4H_2O$.

Cupric copper is reduced to cuprous copper fairly rapidly by carbon monoxide according to the equation $2Cu(NH_3)_4CO_3 + CO + 2H_2O = Cu_2(NH_3)_{2n}CO_3 + 2(NH_4)_2CO_3 + (4 - 2n)NH_3$, whilst the reduction of cuprous copper to metallic copper is comparatively a much slower process, and occurs according to the equation $Cu_2(NH_3)_{2n}CO_3 + CO + 2H_2O = 2(NH_4)_2CO_3 + 2Cu + (2n - 4)NH_3$. Small amounts of oxygen present in the gaseous mixtures, from which the carbon monoxide is to be removed, prevent the precipitation of copper and increase the absorption capacity of the solution. The carbon monoxide can be almost completely removed from the absorption solution by heating it at 75° at atmospheric pressure in an inert atmosphere, and the solution may then be used again for further absorption of carbon monoxide. J. F. S.

Carbon Dioxide in Water of the Gulf of Mexico. ROGER C. WELLS (*U.S. Geo. Sur.*, *Prof. Paper*, 120A, 1918, pp. 1—16).—The total carbon dioxide in the sea-water of the Gulf of Mexico increases with the depth, that is, with decreasing temperature, and the amounts found are very near, though slightly below, those required for equilibrium with atmospheric carbon dioxide. Determinations of the total quantity of base present as carbonate and hydrogen carbonate were also made; this quantity apparently increases slightly with decreasing temperature. An exact computation of the "free" carbon dioxide in the water was not possible, but the results indicated that no appreciable error is made when the total carbon dioxide found is expressed as a mixture of carbonate and hydrogen carbonate. E. H. R.

Silicic Acid Gels. ROBERT SCHWARZ (*Kolloid Zeitsch.*, 1921, **28**, 77—81).—The solubility of silicic acid in ammonia has been studied. It is shown that a solution of silicic acid in ammonia may be separated into two fractions, one which will pass through the finest ultra-filter and therefore consists of molecular disperse silicic acid, that is, ammonium silicate, and the other, which is retained by the ultra-filter and consists of colloidal silicic acid. The amount of dissolved silicic acid has been estimated at various periods after solution, and it is found that the amount increases with time; thus eight hours after solution 30·6% of a given silicic acid gel was dissolved, 16·0% was in the colloidal condition, and 53·4% was undissolved, but in ninety-five hours 63·9% was dissolved, 8·1% was in colloidal solution, and 28·0% was undissolved. From which it is deduced that the colloidal solution is the first stage of the solution and that the true solution is a secondary reaction following the formation of the colloidal solution. J. F. S.

Measurement of Vapour Pressures of certain Potassium Compounds. DANIEL JACKSON and JEROME J. MORGAN (*J. Ind. Eng. Chem.*, 1921, **13**, 110—118).—A method described by von Wartenberg (A., 1912, ii, 1137; 1913, ii, 47) was adapted to the determination of the vapour pressures of potassium compounds with the following results, the values being given in mm. of mercury:

Hydroxide, 8 mm. at, 795°. Chloride, 1·54 mm., at 801°; 8·33 mm. at 948°; 24·1 mm. at 1044°. Carbonate, 1·68 mm. at 970°; 5·0 mm. at 1130°. Sulphate, 0·4 mm. at 1130°. Natural silicates 0 mm. at 1130—1335°.

From the results obtained for potassium chloride, together with the boiling point of this compound as given by Borgstrom, the Nernst vapour pressure formula for potassium chloride has been calculated to be:

$$\text{Log } P = -5326/T + 1{\cdot}75 \log T + 0{\cdot}000511\, T - 0{\cdot}7064.$$

W. P. S.

Crystal Structures of the Ammonium Haloids Above and Below the Transition Temperatures. GUY BARTLETT and IRVING LANGMUIR (*J. Amer. Chem. Soc.*, 1921, **43**, 84—91).—Ammonium chloride, bromide, and iodide are polymorphous and have well-defined transition temperatures. *X*-ray crystal analysis by Hull's method (A., 1919, ii, 1168) shows that the high temperature form of each of these substances has a simple cubic structure like sodium chloride, each ion being surrounded by six equidistant ions of the opposite polarity. The ordinary or low temperature forms of the chloride and bromide show a centred cubic structure, each ion being surrounded by eight equidistant ions of the opposite polarity, arranged as the corners of a cube about its centre. These results furnish confirmatory evidence that the ammonium ion has tetrahedral symmetry, while the alkali and halogen ions are cubic in shape. Low temperatures, high pressures, and anions of small atomic volume cause the shape of the ammonium ions to be a factor of predominating importance in determining the crystal structure. High temperatures, low pressures, and anions of large volume make the shape of the ammonium ion of relatively less importance, so that under these conditions ammonium salts tend to become isomorphous with the corresponding potassium salts. The following data have been obtained: Ammonium chloride, at 20°, distance between like ions l_1, 3·859° Å.U., distance between unlike ions l_2, 3·342°Å.U., density (calculated) D 1·536; at 250°, l_1, 4·620 Å.U., l_2 3·266 Å.U., D 1·265; ammonium bromide, at 20°, l_1, 3·988, l_2, 3·453, D, 2·548; at 250°, l_1, 4·88, l_2, 3·45, D, 1·972; ammonium iodide, at 20°, l_1, 5·090, l_2, 3·62, D, 2·563. J. F. S.

Distribution of a Strong Electrolyte between Water and Benzene. ARTHUR E. HILL (*J. Amer. Chem. Soc.*, 1921, **43**, 254—268).—The molecular weight of silver perchlorate has been determined in benzene solution, and it is shown that this salt exists in benzene solution as single molecules as well as in polymerised molecules of double and triple molecular weight. The average molecular weight up to a concentration 0·14*N* is expressed by the equation $MW = C^{0{\cdot}17}/1{\cdot}571 \times 10^{-3}$. In benzene solution there is no electrolytic dissociation, except possibly of the same order as that of pure water. Silver perchlorate is soluble in chlorobenzene, glycerol, acetic acid, toluene, and nitrobenzene. It is soluble in water at 25° to the extent of 2386 grams per litre of water, and in

anhydrous benzene to the extent 45·29 grams per litre of solution. The saturated aqueous solution has $D_{4^\circ}^{25^\circ}$ 2·806, whilst the saturated benzene solution has $D_{4^\circ}^{25^\circ}$ 0·9053. A method is put forward for calculating the concentration of the three different species of silver perchlorate molecules in benzene solution, and curves are drawn for these concentrations. Distribution experiments show that water extracts the salt completely from its benzene solution up to a concentration 2·3*N* in the aqueous layer. The experiments are interpreted as evidence that silver perchlorate, apparently a typical salt, is completely ionised in water at higher as well as at low concentration. J. F. S.

Crystallisation in Ternary Systems of the Chlorides of Univalent and Bivalent Metals. II. TH. LIEBISCH and EHR. VORTISCH (*Sitzungsber. Preuss. Akad. Wiss. Berlin*, 1920, 426—442. See A., 1917, ii, 248).—Previous investigations are extended by a consideration of the formation of solid solutions. The systems $NaCl-SrCl_2-BaCl_2$ and $KCl-SrCl_2-BaCl_2$ were investigated and the results shown in the form of curves. J.R.P.

Devitrification of Glass: A Surface Phenomenon: Repair of Crystallised Glass Apparatus. ALBERT F. O. GERMANN (*J. Amer. Chem. Soc.*, 1921, **43**, 11—14).—The devitrification of glass in a blowpipe flame is not due to the formation of crystal nuclei within the mass of the glass, but is a surface phenomenon due to the expulsion of water and carbon dioxide, and possibly when the glass is heated for a long time to the volatilisation of sodium oxide. To prevent such devitrification in old glass, it is sufficient to remove the surface layer by washing with diluted hydrofluoric acid solution before heating it. Old apparatus which has been broken may thus be repaired if the places to be heated are thoroughly washed with diluted hydrofluoric acid. J. F. S.

Reactions producing Magnesium. CAMILLE MATIGNON (*Compt. rend.*, 1921, **172**, 381—383).—The following three reactions are suggested as possible methods of preparation of magnesium:—

(1) $MgCl_{2\,sol} + CaC_{2\,sol} = CaCl_{2\,sol} + 2C_{sol} + Mg_{sol} + 22{\cdot}4$ cal.
(2) $MgO_{sol} + CaC_{2\,sol} = CaO_{sol} + 2C_{sol} + Mg_{sol} - 8{\cdot}4$ cal.
(3) $MgOMgCl_{2\,sol} + 2CaC_{2\,sol} = CaOCaCl_{2\,sol} + 4C_{sol} + 2Mg_{sol} - 2{\cdot}2$ cal.

Taking into account the heat of vaporisation of magnesium, it is shown that the absorption of heat per atom of magnesium volatilised is least for the first reaction and greatest for the second. It is possible to obtain magnesium by these methods, but reaction (2), carried out with a calcined dolomite, only proceeded very slowly even at 1300°. Reaction (1) involves the preparation of anhydrous magnesium chloride, which is a delicate and costly process. Attempts to apply these processes on a semi-industrial scale were not successful. W. G.

The Crystal Structure of Magnesium Oxide. RALPH W. G. WYCKOFF (*Amer. J. Sci.*, 1921, [v], **1**, 138—152).—Laue photographs and *X*-ray spectrum measurements were made on

crystals of magnesium oxide, and the results were analysed with the help of the theory of space groups (this vol., ii, 245) in the hope of obtaining a unique solution of the structure of the crystals. The X-ray spectrum measurements do not settle the number of chemical molecules in the space unit, the alternatives being 4 and 32, and at the same time the class of symmetry is left in doubt. If the symmetry is holohedral cubic, the only possible simple solution is a structure similar to that of sodium chloride. Certain groupings showing tetartohedral symmetry, and some more complicated holohedral arrangements with thirty-two molecules associated in the unit would, however, be indistinguishable from the sodium chloride grouping with the experimental means at present available.

E. H. R.

Crystalline Magnesium Carbonate. T. C. N. BROEKSMIT (*Pharm. Weekblad,* 1921, **58**, 210—212).—The amorphous precipitate obtained by addition of sodium carbonate to magnesium sulphate in solution, said in the literature to be a basic carbonate, is found to become crystalline after a time. Exactly similar crystals are obtained from calcium salts under the same conditions. The compound may be that obtained by Schmidt by keeping the clear solution obtained by passing carbon dioxide into a suspension of amorphous magnesium carbonate, when crystals said to have the composition $MgCO_3,3H_2O$ separated in needles. The same crystals are obtained if potassium carbonate or hydrogen carbonate or ammonium carbonate is used, and it is shown that the compound is not a double salt.

S. I. L.

Coloration of Zinc Sulphide by the Action of Light. YÛSHICHI NISHIZAWA (*J. Tokyo Chem. Soc.*, 1920, **41**, 1054—1064).—Zinc sulphide is tinged with light brown or light grey colour by exposure to light or by heating at 60—70°. The coloration is promoted by the presence of magnesium chloride or sulphate, zinc sulphate, or calcium chloride or sulphate, whilst the presence of a minute quantity of the following substances : multivalent alcohols, sugars, starch, oxalic acid, tartrates magnesium hydroxide, etc., inhibits the change. O'Brien (A., 1915, ii, 98) ascribed the coloration to the decomposition of zinc sulphide into zinc and sulphur, but samples which have not been coloured by exposure to light also yield zinc when treated with acetic acid. The author attempted to detect free sulphur in coloured samples, but without success, and suggests the cause of the colour to be the polymerisation of zinc sulphide, this being probable from the position of zinc in the periodic table. Lithopone can be made light-proof by mixing it with reagents such as those mentioned above.

K. K.

Phosphorescence and Fusion of Sulphides of the Second Group, particularly Zinc Sulphide. ERICH TIEDE and ARTHUR SCHLEEDE (*Centr. Min.*, 1921, 154—158).—A further account of work already published (A., 1920, ii, 723, 757).

E. H. R.

Cuprous Oxide obtained by Reduction. V. V. SARMA (*Chem. News*, 1921, **122**, 99—100).—The yellow substance formed by reduction of an alkaline cupric salt with dextrose does not appear to be pure cuprous oxide. It contains a considerable amount of cuprous hydroxide which persists even after heating at 110°. On boiling the yellow substance with water a small portion remains suspended after boiling is discontinued, whilst most of it immediately settles as a granular powder. The heavier portion is not so bright in colour as the lighter one. When a drop or two of sulphuric acid is added to the lighter suspension it dissolves, giving a clear, colourless solution, which remains colourless on the addition of ammonia and only turns blue on keeping in the air. On treating the heavier portion with sulphuric acid it gives a blue solution of cupric sulphate and leaves metallic copper. When the yellow powder is shaken with ether a small portion dissolves and gives a bluish-green solution, and the powder loses its brightness and becomes dull yellow in colour. On heating the yellow substance gently in a tube, a thin, green coating is formed in the cooler parts of the tube and red cuprous oxide is left behind. It is held that the yellow product contains in addition to cuprous oxide 2—3% of water and an appreciable quantity of cuprous hydroxide. If sucrose is used instead of dextrose only red cuprous oxide is formed, irrespective of the temperature and method of reduction.

J. F. S.

Fractional Precipitation. PIERRE JOLIBOIS, ROBERT BOSSUET, and CHEVRY (*Compt. rend.*, 1921, **172**, 373—375).—Using the apparatus previously described (A., 1920, ii, 107, 112), the authors have followed the different phases in the fractional precipitate of a solution containing copper and silver nitrates by sodium hydroxide, and of a solution containing nickel and cobalt chlorides by the same reagent. It is shown that, in the first case, none of the silver is precipitated as silver hydroxide until sufficient sodium hydroxide has been added to precipitate the whole of the copper. Thus the fractionation is quantitative. In the second case the fractionation is imperfect. The precipitate is always richer in nickel than in cobalt.

W. G.

Gallium. Its Electrolytic Behaviour, Purification, Melting Point, Density, Coefficient of Expansion, Compressibility, Surface Tension, and Latent Heat of Fusion. THEODORE W. RICHARDS and SYLVESTER BOYER (*J. Amer. Chem. Soc.*, 1920, **43**, 274—294).—The purification of gallium, its electrolytic behaviour, and several of its physical constants have been investigated. It is shown that the single electrode potential of gallium is not easily reproducible at a constant value. It reached as a maximum only -0.30 volt in $0.1N$ solution (the calomel electrode being taken as $+0.56$ volt), apparently placing gallium between indium and zinc in the electrochemical series. On the other hand, gallium is distinctly more difficult to precipitate electrolytically from acid solutions than zinc. From this behaviour gallium might be expected

to have a single electrode potential of at least $-0{\cdot}7$. It may be precipitated in weakly acid solutions if a sufficiently large current density is employed. A possible explanation of this apparent inconsistency is to ascribe a mild degree of passivity to gallium—an explanation in keeping with the fact that pure gallium precipitates copper only very slowly from its solutions. After preliminary purification by electrolysis, which easily eliminates indium and many other metals, pure gallium was freed from zinc by ignition in a high vacuum or by crystallisation, giving material of constant melting point. The melting point on the international hydrogen scale is 29·75°. The purest material has D 5·904 for the solid and D 6·095 for the liquid, both at the melting point. The expansion 0·00531 c.c. per gram on solidification is shown not to be due to impurities. The compressibility of solid gallium at 20° is 0·0000020 and that of the liquid about twice as great. The coefficient of cubical expansion of solid gallium is 0·000055. Hence $D^{20} = 5{\cdot}907$ and its atomic volume 11·85. The surface tension of liquid gallium in carbon dioxide at 30° is 36·54 mg./mm. The latent heat of fusion, calculated by the Clapeyron formula and the change of the melting point with pressure, was found to be 19·04 cal. per gram at 173 megabars pressure, that is, the melting point is lowered 0·00207° by an increase in pressure of one atmosphere. J. F. S.

Separation of Gallium from Indium and Zinc by Fractional Crystallisation of the Cæsium Gallium Alum. Philip E. Browning and Lyman E. Porter (*J. Amer. Chem. Soc.*, 1921, **43**, 126).—Fractionation of a solution of a mixture of gallium and indium cæsium alums containing gallium and indium in the ratio $Ga_2O_3 : In_2O_3 = 26{\cdot}5 : 73{\cdot}5$ gave a first crop of crystals containing the oxide in the ratio $Ga_2O_3 : In_2O_3 = 14{\cdot}9 : 85{\cdot}1$. After five fractions had been obtained it was found that the first consisted entirely of gallium, whilst the fifth contained the two oxides in the ratio $Ga_2O_3 : In_2O_3 = 0{\cdot}6 : 99{\cdot}4$. Recrystallisation of a mixture of zinc sulphate and gallium cæsium alum of the composition 2 grams of ZnO and 1·0 gram of cæsium gallium alum gave on the first recrystallisation crystals containing $Ga_2O_3 : ZnO = 98 : 2$, and after the second recrystallisation no zinc could be detected. J. F. S.

Reduction by Metals in Acid Solutions. I. The Reduction of Acid Ferric Sulphate Solutions by Zinc and Magnesium. Samuel Sugden (T., 1921, **119**, 233—238).

System and Constitution of Derivatives of Molybdic Acid. II. L. Forsén (*Compt. rend.*, 1921, **172**, 327—330. Compare this vol., ii, 205).—The author considers that the most probable formula for metamolybdic acid is $[Mo_{12}O_{42}H_6]H_6$, and gives for it a constitutional formula showing it as a product of condensation of four molecules of molybdic acid (*loc. cit.*). He has converted molybdic acid into metamolybdic acid by warming it with hydrochloric acid and a little nitric acid. W. G.

Identity of Trechmann's "β-Tin" with Stannous Sulphide. L. J. SPENCER (*Min. Mag.*, 1921, **19**, 113—123).—A re-examination of the original material described by C. O. Trechmann in 1879 (A., 1882, 576) as an orthorhombic modification of tin proves that he made his crystallographic determinations on crystals of one kind (namely, stannous sulphide), whilst the chemical analysis was made on crystals of another kind (namely, metallic tin). Tin is therefore dimorphous, and not trimorphous, "white tin" being tetragonal and "grey tin" cubic. Orthorhombic crystals ($a : b : c = 0.3874 : 1 : 0.3558$, Trechmann) of stannous sulphide, SnS, are produced, under certain conditions, in considerable quantity during the process of tin smelting. The material has the form of thin, flexible plates and scales with an iron-black colour and metallic lustre, somewhat resembling graphite in appearance and hardness (H 2). It dissolves in hydrochloric acid with evolution of hydrogen sulphide. Analysis of material from which globules of tin and needles of iron stannide could not be separated gave: Sn 81·48, Fe 1·70, S 15·14, insoluble 0·90, total 99·22, D 5·52, corresponding with SnS 72·2, Sn 15·0, $FeSn_3$ 12·8%, and re-calculated D for the SnS 5·0 (previous determinations range from 4·852 to 6·557). The associated tetragonal needles of iron stannide are tin-white with brilliant metallic lustre, brittle, and non-magnetic. They dissolve in hydrochloric acid with evolution of hydrogen. Analysis gave Sn 84·94, Fe 13·48, S 0·24, total 98·66, D 7·77, corresponding with $FeSn_3$. Rhombohedral tin arsenide, Sn_3As_2 (Sn 70·22—70·62, As 29·78—29·38%) was prepared by J. E. Stead by slowly cooling an alloy containing Sn 95, As 5%; the crystals ($a : c = 1 : 1.2538$) have the form of thin graphite-like scales. L. J. S.

Preparation of Insoluble Thorium Compounds [Double Metaphosphate and Sulphate of Thorium]. LINDSAY LIGHT Co., Brit. Pat., 156892).—A double metaphosphate and sulphate of thorium, $Th(PO_3)_2SO_4$, of the same composition but purer than the compound obtained by heating with sulphuric acid at a high temperature a natural mineral containing thorium and phosphates such as monazite sand (cf. U.S. Pat., 1323735), is prepared in the form of white, acicular crystals by dissolving 120 grams of thorium sulphate, $Th(SO_4)_2,8H_2O$, in 50 c.c. of 80% phosphoric acid, and heating for ten hours at 280°. Water and sulphuric acid fumes are evolved and the product forms a nearly solid, crystalline mass, insoluble in water or in dilute acids. The same substance is also obtained by heating thorium phosphate with an equal weight of sulphuric acid, preferably in presence of 20—40% of phosphoric acid, for ten hours at a temperature above 260°. G. F. M.

Preparation of Spongy Platinum. R. FEULGEN (*Ber.*, 1921, **54**, [*B*], 360—361).—The following method yields a material which does not tend to pass into colloidal solution during the process of washing and before removal of the chloride is complete.

A solution of chloroplatinic acid (5 grams) in water (5 c.c.) is mixed with formaldehyde solution (40%, 7 c.c.), and sodium

hydroxide (5 grams) dissolved in water (10 c.c.) is gradually added. The mixture is allowed to remain for half an hour at the ordinary temperature, then heated for fifteen minutes at 55° and poured into a half-litre flask half full of water. The flask is agitated violently for a few minutes, which causes the precipitate to settle in coarse particles leaving an almost colourless supernatant liquor. The latter is decanted and the precipitate is washed with water strongly acidified with acetic acid, which again causes the formation of coarse particles which can now be washed as requisite without showing any tendency to pass into the colloidal state. The metal is finally filtered and dried in a vacuum over sulphuric acid. Great caution must be observed in the subsequent admission of air into the desiccator as the metal readily becomes incandescent owing to absorption of oxygen. Previous to use, it is advisable to grind and wash it once more. A very active catalyst is thus obtained.

H. W.

Action of Hydrochloric Acid on the Tetroxides of Osmium and Ruthenium. HEINRICH REMY (*J. pr. Chem.*, 1920, [ii], **101**, 341—352).—The contradiction between the observation of Milbauer (A., 1918, ii, 202) that osmium tetroxide is decomposed by concentrated hydrochloric acid at the ordinary temperature, and that of Ruff and Mugdan (A., 1919, ii, 108) that no action occurs, is due to differences in the strengths of acid employed. Acid with D>1·160 reacts at the ordinary temperature, giving osmium tetrachloride (compare Milbauer, *loc. cit.*); ruthenium tetroxide reacts still more easily (compare Ruff and Mugdan, *loc. cit.*), forming the trichloride. J. K.

Mineralogical Chemistry.

A New Variety of Antimoniferous Bismuth Sulphide. S. PIÑA DE RÚBIES (*Anal. Fís. Quim.*, 1920, **18**, 335—338).—An antimoniferous variety of bismuth sulpho-telluride has been found associated with oruetite (A., 1919, ii, 235). The minerals are almost identical in appearance, colour, etc., but differ slightly in hardness. The new variety has D 6·8, whilst oruetite has D 7·8. As a criterion for the separation of fragments of the two varieties, electrical conductivity has been used. The composition of the new variety is as follows:

Bi.	Sb.	Pb.	Sn.	S.	Te-Se.	Cu.	As.
73·38	4·50	0·82	0·09	17·08	4·98	trace	trace

The composition corresponds with the formula

$$8Bi_2S_3,Sb_2S_3,Bi_2(Se,Te)_3.$$

G. W. R.

Minerals from Slata, Tunis. H. BUTTGENBACH (*Bull. Soc. franç. Min.*, 1920, **43**, 24—67).—A crystallographic description of fine crystals of cerussite, anglesite, etc. Colourless crystals of calcite enclose brown filaments, which, as shown by the following analysis, consist of a hydroxide of iron and aluminium with the composition $3Al_2O_3,3Fe_2O_3,2H_2O$:

CaO.	Fe_2O_3.	Al_2O_3.	H_2O.	CO_2.	Total.
53·44	2·54	1·58	0·38	42·02	99·96

L. J. S.

Sarcopside from New Hampshire. EDW. F. HOLDEN (*Amer. Min.*, 1920, **5**, 99—102, 166).—This mineral (M. Websky, 1868) has sometimes been regarded as altered triplite. It is, however, probably a distinct species, as shown by an exmination of fresh material found in pegmatite at Deering, New Hampshire. This forms irregular slabs with fibrous structure and silky lustre. The colour is flesh-red to lavender, but soon alters on exposure to blue, green, or brown; the streak is pale straw-yellow. D 3·64, H 4, n 1·725. Analysis gave:

Fe_2O_3.	FeO.	MnO.	CaO.	MgO.	P_2O_5.	F.	H_2O.	Insol.	Total less O for F.
1·70	39·87	10·83	4·38	0·68	33·26	4·35	1·53	3·22	97·99

Neglecting water (which is expelled below 110°) and calculating all the iron as ferrous, this gives the formula $2R_3P_2O_8,RF_2$ or $R_7F_2(PO_4)_4$, in which the ratios lie between those of triplite and apatite. Griphite is perhaps an impure form of sarcopside.

L. J. S.

Trigonite and Dixenite, Two New Minerals from Långban, Sweden. GUST. FLINK (*Geol. För. Förh.*, 1920, **42**, 436—452).—Trigonite is found together with native lead in crevices in dolomite. The crystals are monoclinic with domatic hemihedrism (clinohedral class), and have the form of triangular wedges;

$$a:b:c = 1·07395:1:1·65897, \beta = 91° 31'.$$

They are sub-transparent with sulphur-yellow colour and vitreous to adamantine lustre. D 8·28, H 2—3; refractive indices α 2·08, γ 2·16. Easily soluble in dilute nitric acid. Analysis I, by R. Mauzelius, gives the formula $Pb_3MnH(AsO_3)_3$.

	As_2O_3.	SiO_2.	PbO.	FeO.	MnO.	CaO.	MgO.	H_2O.	Insol.	Total.
I.	28·83	—	63·40	0·15	6·79	0·23	0·11	0·81	0·13	100·45
II.	30·55	8·66	—	4·54	48·94	0·28	0·50	3·38	—	100·32*

Dixenite forms aggregates of thin folia in crevices of fine-grained hæmatite or in dolomite. It is black and sub-translucent with resinous to metallic lustre; by transmitted light a glowing red; optically uniaxial and positive. X-ray photographs show it to be rhombohedral or hexagonal. D 4·20, H 3—4, mean refractive index 1·96. Easily soluble in hydrochloric acid with separation of part of the silica. Analysis II, by R. Mauzelius, gives the formula $(MnOH)_2Mn_3SiO_3(AsO_3)_2$ or $MnSiO_3 + 2(MnOH)MnAsO_3$.

L. J. S.

* Including P_2O_5 0·09, CuO 3·38.

Armangite, a new Arsenite from Långban, Sweden. G. AMINOFF and R. MAUZELIUS (*Geol. För. Förh.*, 1920, **42**, 301—309).—The mineral occurs in calcite veins with barytes, fluorite, hæmatite, etc. Crystals are rhombohedral ($a : c = 1 : 1\cdot3116$); H 4, D 4·23. Colour black, streak brown, thin slices brown to yellow; optically uniaxial and negative; refractive indices high ($>1\cdot79, <1\cdot93$). Analysis by R. Mauzelius gave:

As_2O_3.	Sb_2O_3.	PbO.	FeO.	MnO.	CaO.	MgO.	H_2O.	CO_2.	Insol.	Total.
42·92	0·40	0·32	2·19	45·06	2·83	0·49	0·71	5·08	0·20	100·20

The mineral dissolves readily in hydrochloric acid with separation of arsenic trioxide. An attempt was made to determine the degree of oxidation of the arsenic. The carbon dioxide appears to be always present as admixed carbonates (of manganese, calcium, and magnesium, amounting to 12%); deducting these and limonite, the formula is that of an ortho-arsenite, $Mn_3(AsO_3)_2$. Only two mineral arsenites, ecdemite and trippkeite, have previously been known. L. J. S.

Pitchblende, Monazite, etc., from Bengal. G. H. TIPPER (*Rec. Geol. Surv. India*, 1919, **50**, 255—262).—These minerals are found, together with torbernite, autunite, apatite, and columbite, in pegmatite near the village of Pichhli in the Gaya district. The pitchblende (anal. I) forms the core of pale yellow, soft, and friable nodules of uranium-ochre (anal. II); cubo-octahedra of uranium-ochre pseudomorphous after pitchblende are also found. The following partial analyses indicate the nature of the change. Both minerals when dissolved in nitric acid evolve much gas.

	SiO_2.	U_3O_8.	Rare-earths, including Th.	PbO.	$\underbrace{\text{Fe. Mn. Ba.}}$	P_2O_5.	Sp. gr.
I.	1·16	66·24	13·9	12·49	n.d.	—	6·68
II.	12·09	34·74	23·16	19·1	n.d.	n.d.	—

Monazite as large crystals and crystalline masses (up to 1½ kilos) has D 5·2 and contains ThO_2 9·95%. Columbite crystals weigh up to 6 kilos; D 5·28—5·52. L. J. S.

Japanese Minerals containing Rare Elements. I. Analysis of Naegite, Fergusonite, and Monazite, from Naegi, Mino Province. YÛJI SHIBATA and KENJIRÔ KIMURA (*J. Chem. Soc. Japan*, 1921, **42**, 1—16).—Naegite gave on analysis:

ZrO_2.	SiO_2.	$(Nb,Ta)_2O_5$.	ThO_2.	Rare earths.	UO_2.	Fe_2O_3.	H_2O <110°.	H_2O >110°.	Total.
53·03	29·55	1·12	2·85	6·68	2·69	1·42	0·72	2·05	100·11

The following rare earths were detected spectroscopically: Ce, Nd, La, Pr, Sm; Y, Dy, Er, Yb, Gd, Tb, and Ho.

Fergusonite gave on analysis:

SiO_2.	$(Nb,Ta)_2O_5$.	TiO_2.	ThO_2.	CeO_2.	Nd_2O_3, etc.	Y_2O_3, etc.
2·83	43·77	1·65	2·91	1·26	1·99	37·64

UO_2.	Fe_2O_3.	Al_2O_3.	CaO.	H_2O <110°.	H_2O >110°.	Total.
0·85	3·97	0·20	1·16	0·24	1·85	100·32

Spectroscopic evidence was obtained of the presence of the following rare earths: Ce, Nd, Sm, La; Y, Dy, Er, Yb, and Gd.

The sample of monazite sand contained P_2O_5 20·42%, SiO_2 10·81%, ThO_2 8·52%, Ce_2O_3 19·44%, Nd_2O_3 etc., 19·70% Dy_2O_3 etc. 3·54%. $H_2O<110°$ 0·69%, $H_2O>110°$ 1·64%. Traces of TiO_2, Nb_2O_5, Ta_2O_5, and ZrO_2, Al_2O_3, Fe_2O_3, CaO, and MgO, etc., were not estimated. The presence of the following rare earths, Ce, Nd, La, Sm, Pr; Dy, Yb, Gd, Er, Eu, Tb, Y, Ho, Tu, and Ru, was shown spectroscopically. K. K.

Plazolite, a New Mineral. WILLIAM F. FOSHAG (*Amer. Min.*, 1920, **5**, 183—185).—This occurs in the metamorphic limestone at Crestmore, California (A., 1919, ii, 113), as small, colourless rhombic dodecahedra embedded in an undetermined foliated white mineral. It is brittle with conchoidal fracture and glassy lustre; D 3·129, H 6½, *n* 1·710. It is easily soluble in hydrochloric acid. The powdered mineral has a slightly alkaline reaction, but strong after ignition. At 150° the loss is only 0·21%. Analyses I–III give the formula $3CaO,Al_2O_3,2(SiO_2,CO_2),2H_2O$, in which carbon dioxide is assumed to replace silica. The high ratio of bases requires a complex grouping to satisfy an orthosilicate formula. The mineral appears to be most nearly related to sodalite.

	SiO_2.	Al_2O_3.	CaO.	MgO.	H_2O.	CO_2.	Total.
I.	24·13	23·66	40·22	0·12	12·21		100·34
II.	23·85	22·77	40·13	—	9·39	3·41	99·55
III.	25·06	24·63	40·13	trace	9·04	1·13	99·99

L. J. S.

Analytical Chemistry.

The Indicator Properties of Two New Phthaleins (1:2:3-Xylenolphthalein and ortho-α-Naphtholphthalein). WILHELM CSÁNYI (*Zeitsch. Elektrochem.*, 1921, **27**, 64—68).—The phthalein from 1:2:3-xylenol and phthalic anhydride is a valuable indicator, the change from colourless to blue being completed within the range of hydrogen-ion concentrations p_H 8·9 and 10·2. It has the advantage that the colour is unaffected by excess of alkali or by alcohol. Ortho-α-naphtholphthalein shows a colour change at about the same hydrogen-ion concentration, but as the colour change is less sharp, the substance is but slightly soluble in water and alcohol, and the colour is discharged by excess of alkali; it is less valuable as an indicator than the xylenolphthalein. E. H. R.

Separating Funnel for Quantitative Extractions. R. LUTHER (*Zeitsch. angew. Chem.*, 1921, **34**, 66—67).—The stem of the tap is not placed directly below the lower part of the funnel, and the bore of the tap is inclined to connect these two parts; a half-turn of the tap cuts off the funnel from the stem and at

the same time connects the latter with a small funnel open to the air; any liquid retained in the stem is thus discharged, and, if required, the stem may be washed out by introducing water or other liquid into the small funnel. W. P. S.

A Probable Error in Estimations by means of the Hydrogen Electrode. C. LOVATT EVANS (*J. Physiol.*, 1921, **54**, 353—366).—Electrometric measurements of the reaction of the blood or bicarbonate solutions yield results which represent H-ion concentrations about 60% higher (P_H 0·2 lower) than those given by the colorimetric method of Dale and Evans (this vol., i, 142). The latter values are regarded as correct, and agree with calculations based on the apparent dissociation constant of carbonic acid (k) and the degree of ionisation of bicarbonate (δ) as determined by conductivity measurements (Walker and Cormack, T., 1900, **77**, 13). When constants (k or δ) derived from hydrogen electrode measurements are used in calculating the P_H of bicarbonate solutions, the results naturally agree with those of direct observation by means of the hydrogen electrode, because in such a calculation k is larger or δ smaller than is found by the conductivity method. Such calculated results obviously do not agree with colorimetric determinations. A source of error in the hydrogen electrode lies in the catalytic production of formic acid, when the solution in the hydrogen electrode contains carbonates. G. B.

A Simple Apparatus for the Identification of Gases Evolved in the Qualitative Tests for Acids. EUGÈNE LUDWIG (*Bul. Soc. Chim. România*, 1920, **2**, 20—23).—The apparatus consists essentially of a small reaction flask, fitted with a cork carrying a safety thistle funnel, the two bulbs of which are joined by a capillary tube in which the suitable reagent for detecting the particular gas expected is placed. Only a very small amount of reagent is required, and hence a trace of a gas may be detected. W. G.

Microchemical Analysis with Reagents Sensitised by Saturation. EUGÈNE LUDWIG (*Bul. Soc. Chim. România*, 1920, **2**, 28—32).—The reagent to be used is saturated with a salt containing the ion which is to be detected, the formation of a precipitate being observed under a microscope. Thus $N/2$-silver nitrate saturated with sodium sulphate may be used for the detection of sulphates; a solution of potassium pyroantimonate saturated with sodium chloride for the detection of sodium, and a solution of platinic chloride saturated with potassium chloride for the detection of potassium. W. G.

Microchemical Analysis with Reagents Sensitised by Saturation. EUGÈNE LUDWIG and D. BUTESCU (*Bul. Soc. Chim. România*, 1920, **2**, 32—35. Compare preceding abstract).—The reagents recommended are, $N/2$-silver nitrate treated with sodium acetate until a precipitate just appears, for the detection of acetates; a solution of uranyl acetate saturated with a sodium

salt for the detection of sodium. For the identification of borax a $N/2$-solution of silver nitrate is recommended. On the addition of a few particles of borax to this solution very small crystals appear, and on warming the slide gently the undissolved particles become black. W. G.

Action of Iodine in the Cold on Different Metals. Detection of the Presence of Chlorine in the Atmosphere. CAMILLE MATIGNON (*Compt. rend.*, 1921, **172**, 532—534).—Iodine placed on thin sheets of metals such as silver, copper, aluminium, tin, or zinc gradually converts the whole of the metal into the iodide at the ordinary temperature, the velocity of the reaction varying with the metal. This change may be adapted for the detection of chlorine in the atmosphere. A thin sheet of beaten silver 1 cm. in diameter, forming part of an electric circuit, is covered with damp potassium iodide and exposed to the air. Any chlorine in the air decomposes the potassium iodide, and the iodine liberated speedily converts the silver into silver iodide and the electric circuit is thus broken, and by a suitable arrangement an audible warning may be given. W. G.

A Method for the Estimation of Chlorides in Small Quantities of Liquids. STEFAN RUSZNYÁK (*Biochem. Zeitsch.*, 1921, **114**, 23—26).—The application of Korányi's method as a micromethod for the estimation of chlorides is described. Exact results are obtained by this method. S. S. Z.

Estimation of Chlorides in Trichloroacetic Acid Filtrates from Whole Blood and Plasma. MILLARD SMITH (*J. Biol. Chem.*, 1921, **45**, 437—447).—The use of trichloroacetic acid as a precipitant for proteins in blood and plasma does not interfere with the estimation of chlorides. Certain modifications of the process are given. J. C. D.

A System of Blood Analysis. II. Simplified Method for the Estimation of Chlorides in Blood or Plasma. J. C. WHITEHORN (*J. Biol. Chem.*, 1921, **45**, 449—460).—Proteins are removed by the reagents employed by Folin and Wu in their system of blood analysis (A., 1919, ii, 308). Chlorides are estimated in the protein-free filtrate by a modified Volhard method. J. C. D.

The Estimation of Chlorides in Blood Plasma. J. HAROLD AUSTIN and DONALD D. VAN SLYKE (*J. Biol. Chem.*, 1921, **45**, 461—463).—It is advisable to remove proteins by a preliminary precipitation before making the estimation of chlorides. J. C. D.

Estimation of Chlorine in Solid Tissues. RICHARD D. BELL and EDWARD A. DOISY (*J. Biol. Chem.*, 1921, **45**, 427—435).—The sample of tissue is decomposed in a small digestion tube by heating with strong sulphuric acid and ammonium or potassium

persulphate, a small globule of mercury being added to act as a catalyst. The gases formed during the incineration are drawn by a current of air into absorption tubes containing sodium carbonate.

After the digestion is completed the liquid in the absorption tubes is transferred quantitatively to a 150 c.c. Erlenmeyer flask, neutralised with sulphuric acid, using methyl-orange as indicator, and the carbon dioxide and sulphur dioxide are expelled by boiling. The chlorine present as chloride is then estimated by one of the usual methods. J. C. D.

A New Method for the Detection of Chlorine and Bromine Ions in the Presence of Iodine Ions. EUGENE LUDWIG (*Bul. Soc. Chim. România*, 1920, **2**, 23—28).—The halogens are precipitated with silver nitrate in boiling acid solution, the precipitate being collected and washed till free from silver nitrate. A portion is then boiled with as small an amount as possible of *N*/10-ammonium hydroxide solution. If the solution so obtained becomes turbid on the addition of a trace of a soluble chloride, chlorine ions were originally present. A somewhat more delicate test is to add one drop of a concentrated solution of sodium bromide. If the liquid remains clear, chlorine and bromine ions were originally absent. A slight turbidity at this stage may be due to bromine ions or a trace of chlorine ions originally present, and to confirm the presence or absence of bromides another portion of the silver haloid precipitate is boiled with *N*-ammonia, and the solution obtained is treated with zinc and an excess of sulphuric acid and warmed. When the action is completed the liquid is decanted and tested for bromine by the addition of chlorine water in the presence of chloroform in the usual manner. W. G.

A New Method for the Estimation of Bromine in very small Quantities. ERNST OPPENHEIMER (*Arch. Expt. Path. Pharm.*, 1921, **89**, 17—28).—Schiff's reagent is coloured deep blue violet by bromine. On the addition of chlorine water to such a solution when acidified with sulphuric acid it becomes intensively violet, greyish-violet, and eventually, when there is an excess of chlorine, golden-yellow. These colorations are utilised by the author for the estimation of small quantities of bromine. S. S. Z.

Electro-titration of Hydriodic Acid and its use as a Standard in Oxidimetry. W. S. HENDRIXSON (*J. Amer. Chem. Soc.*, 1921, **43**, 14—23).—Solutions of iodides in dilute sulphuric acid may be accurately titrated electrometrically with potassium permanganate. The reaction is carried out in a bottle with three necks, through one the end of the burette passes; a narrow tube by which air or carbon dioxide is passed enters by the second neck, and the third carries a bright platinum electrode and the connecting tube of a calomel electrode. The gas is passed in simply for the purpose of stirring the solution. The *E.M.F.* of the system is determined as the titration proceeds, and the point

where a sudden increase occurs is the end point of the reaction. The reaction is affected by the presence of chlorides or bromides, but may be carried out if the amount of chloride does not exceed that of the iodide, and if the bromide concentration does not exceed a quarter of that of the chloride. Dichromate and iodate as oxidisers in 0·02N and 0·05N solutions may be accurately titrated by adding solutions of either to a measured excess of an iodide in sulphuric acid solution, and titrating the excess of iodide with permanganate as described above. Silver has been estimated in the same way. It is shown that the high results obtained by Crotogino in titrating iodide with permanganate were not due to the formation of iodic acid before the end point was reached (A., 1900, ii, 685). Using this method, potassium dichromate shows its theoretical oxidising power. J. F. S.

Volumetric Estimation of Polysulphide-sulphur. A. Wöber (*Zeitsch. angew. Chem.*, 1921, **34**, 73).—A measured quantity of the polysulphide solution, diluted previously with boiled water, is added to an excess of 10% sodium sulphite solution and the mixture is heated at 50° until colourless; the polysulphide reacts with the sulphite, yielding thiosulphate. After fifteen minutes, the solution is diluted to a definite volume and the thiosulphate is estimated in an aliquot portion by Bodnár's method (A., 1915, ii, 161, 629). If the polysulphide already contains thiosulphate, this must be estimated previously and an allowance made for its quantity. When the polysulphide contains alkali carbonate, it must be treated with cadmium acetate or zinc sulphate before the thiosulphate is estimated. W. P. S.

Estimation of Nitric Acid. L. W. Winkler (*Zeitsch. angew. Chem.*, 1921, **34**, 46).—In the estimation of nitric acid as nitron nitrate (cf. Treadwell's handbook), acetic acid (1 c.c. of the glacial acid per 100 c.c. of neutral solution) is preferable to sulphuric acid for acidifying the original solution. Cooling to 0° may be avoided by keeping the reaction mixture for twenty-four hours in the dark at 15—20°. The precipitate may be collected on a small felt of cotton wool in a cup-shaped filter, instead of on a Gooch crucible. The 10 c.c. of ice-cold water prescribed by Treadwell for washing is quite insufficient; 50 c.c. of a saturated solution of nitron nitrate at the ordinary temperature may be used, the last washing being removed as completely as possible by suction. The accuracy of the method is not affected by the presence of sulphates or iodates, but chlorides lead to high results which may be corrected by reference to a table. J. H. L.

A Short Test for Easily Soluble Phosphate in Soils. O. M. Shedd (*Soil Sci.*, 1921, **11**, 111—122).—In the first part of the paper a preliminary account is given of some work on the reaction between dilute acids and the phosphorus compounds of the soil, the results of which agree fairly well with those of Russell and Prescott (*J. Agric. Sci.*, 1916, **8**, 6).

The test described consists in shaking 10 grams of air-dried soil with 25 c.c. of *N*/5-nitric acid for five minutes, filtering the solution and adding to the filtrate, collected in a standard size test-tube, 1 or 2 c.c. of a 60% solution of ammonium nitrate and 5 c.c. of ammonium molybdate solution. The contents of the tube are heated at 60°, shaken several times and allowed to remain. The volume of the precipitate is judged by the eye and the soluble phosphate in the soil classed as "large," "fair," "moderate," "very moderate," etc., in decreasing order of precipitate obtained. This classification of different soils is in agreement with that obtained by digesting the soils for five hours with larger amounts of nitric acid and determining the extracted phosphate quantitatively. Any soil classed as very moderate to moderate or under, that is, containing 0·005—0·0075% or less of soluble phosphorus, will probably respond to applications of phosphatic fertilisers.
W. G.

Estimation of Citric-soluble Phosphate in Superphosphate. P. MÜLLER (*Chem. Zeit.*, 1921, **45**, 178).—In the estimation of citric-soluble phosphate, complete precipitation of the magnesium ammonium phosphate is not secured by shaking for half an hour; the precipitate must be left over night before filtering. Comparative estimations made directly after shaking, and after keeping, indicated that in the former case the results are too low, the average difference for seven tests being 0·44%. The slowness of precipitation is probably due to the presence of other salts. W. J. W.

Detection of Arsenic. L. W. WINKLER (*Pharm. Zentr.-h.*, 1921, **62**, 125—128).—Bettendorf's reagent (stannous chloride in hydrochloric acid solution) will detect 0·01 mg. of arsenic trioxide in 2 c.c. of solution; the presence of sulphuric acid does not interfere. In testing dark coloured solutions, the latter should be treated with zinc and sulphuric acid, the evolved gases passed through hydrochloric acid, and the latter then tested with the reagent. The evolved gases may also be passed through Nessler reagent; a precipitate is obtained if arsenic is present, but antimony, phosphorus, and sulphur compounds yield a similar reaction. A test, similar to the Gutzeit test, is described, the arsenic being detected by means of filter paper moistened with gold chloride.
W. P. S.

The Estimation of Arsenic in Organic Compounds. GEORGE ROSS ROBERTSON (*J. Amer. Chem. Soc.*, 1921, **43**, 182—185).—The compound is oxidised with a mixture of nitric and sulphuric acids (compare Morgan, "Organic Compounds of Arsenic and Antimony," 1918, 349), the liquid is freed from nitrous compounds by means of ammonium sulphate, and the arsenic estimated by the method of Gooch and Morris (A., 1900, ii, 686). The results by this rapid method are quite comparable with those from the Carius method. W. G.

Sensitive Test for the Hydrides of Arsenic, Antimony, and Phosphorus by Means of Gold Chloride. WALTHER ZIMMERMANN (*Apoth. Zeit.*, 1921, **36**, 26; from *Chem. Zentr.*, 1921, ii, 431).—Basing his experiments on Lehbert's observation that gold chloride is reduced by arsenic trihydride, the author has shown that a drop of sodium aurichloride solution spread on a piece of filter paper is scarcely affected by pure hydrogen, but is coloured violet by small amounts of the hydrides of arsenic, antimony, or phosphorus. A distinct coloration was obtained with 0·00284 mg. As in liquor kali arsenicosi in two minutes, and a recognisable reaction with 0·00015 mg. As in salvarsan in ten minutes; distinct and slight reactions were observed with 0·00124 mg. Sb in potassium antimonyl tartrate in five minutes, and with 0·25 mg. P in calcium hypophosphorosum respectively. Organic matter must be destroyed; hydrogen sulphide interferes with the reaction by giving a brown coloration. H. W.

Criticism of the Methods of Estimating Small Amounts of Carbon Monoxide in Air and in Flue Gases. DANIEL FLORENTIN and H. VANDENBERGHE (*Compt. rend.*, 1921, **172**, 391—393).—The two methods considered are Gautier's method, in which the carbon monoxide is oxidised by iodic anhydride (A., 1898, ii, 537) and the method of Ogier and Kohn-Abrest (A., 1908, ii, 631, 632) depending on the formation of carboxyhæmoglobin. The first method is open to the objection that other gases, not easy to remove, may be present, which also oxidise iodic anhydride. Certain manipulative precautions are indicated, and the authors do not apparently favour this method. They obtained concordant results by the second method, but advise each analyst to prepare his own scale. If the air or gas to be analysed contains more than 1 part of carbon monoxide per 1000 it should be first diluted before being passed through the hæmoglobin solution. W. G.

Simplified Methods of Analysis in the Calcium Group. EUGÈNE LUDWIG and (MLLE) HÉLÈNE SPIRESCU (*Bul. Soc. chim. România*, 1920, **2**, 35—37).—Strontium is in every case detected by the flame test. By precipitation of the metals of this group with ammonium carbonate in the presence of ammonium chloride, the filtrate will in every case contain sufficient calcium and barium, if these elements are present, to permit of their detection with ammonium oxalate and sulphuric acid respectively. Alternatively, ammonium oxalate is used as the group precipitant. The filtrate will then contain sufficient barium for its detection with sulphuric acid, and calcium may be detected microchemically in the precipitate by treatment with sulphuric acid (Behrens-Kley, *Microchemische Analyse*, 1915). W. G.

Importance of Adsorption in Analytical Chemistry. VI. Adsorption of Lead and Copper by Filter-paper. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 152—159. Compare this vol., ii, 213).—Lead is not completely adsorbed from its solutions

by filter-papers with low ash-alkalinity. If, however, the solution is treated with sodium hydroxide solution containing carbonate, most of the lead is precipitated and the remainder absorbed, and on subsequently treating the filter with acetic acid, all the lead is re-dissolved. This method may be applied to the estimation of lead in drinking water, but a preliminary blank test for lead in the filter paper must be made. For the quantitative estimation, the lead in the solution, before and after adsorption, is precipitated as sulphite and collected on asbestos. The precipitate is then oxidised with bromine, and excess of the latter determined iodometrically. With high concentrations, adsorption is proportional to the alkalinity of the filter ash, and to remove lead entirely from its solutions by means of filter-paper or cotton wool, these must have a high alkalinity; no appreciable quantities of lead are adsorbed when the ash-alkalinity is negligible.

Adsorption of copper by filter-paper is very slight, and bears no relation to the alkalinity of the ash. From solutions in distilled water, more copper is adsorbed than from solutions to which sodium carbonate or ammonia is added. From dilute ammoniacal solutions of copper more is adsorbed than from those of higher concentration. In contradistinction to that of lead, the adsorption of copper from neutral solutions is negligible, but from solutions in ammonia a high adsorption takes place. W. J. W.

The Importance of Adsorption in Analytical Chemistry. VII. The Adsorption of Silver, Mercury, and Other Metals. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 233—241).—The taking up of heavy metals from solutions of their salts by cotton-wool and filter paper is not a physical adsorption, but is a result of chemical action with the ash of the cellulose, which functions as a permutite in which the bivalent anion may be replaced by hydrion or a heavy metal ion. Pure ash-free cellulose would probably not take up metals at all. The quantities fixed by ordinary ash-containing cellulose may be much reduced by addition of acid to the solutions. S. I. L.

Use of Gallium Ferrocyanide in Analysis. LYMAN E. PORTER and PHILIP E. BROWNING (*J. Amer. Chem. Soc.*, 1921, **43**, 111—114).—Gallium ferrocyanide may be filtered by suction if a pad made of shredded filter-paper is placed on top of a double filter-paper and the suction employed is gentle. The precipitate after washing is ignited and weighed as the mixed oxides of gallium and iron. Gallium may be recovered from the ferrocyanide by treating with sodium hydroxide, whereby the whole passes into solution as sodium ferrocyanide and an alkali salt of gallium, and then treating with carbon dioxide, which precipitates the gallium as hydroxide. An alternative method consists in treating the alkaline solution of gallium ferrocyanide with hydrogen peroxide to oxidise the sodium ferrocyanide to sodium ferricyanide, and then boiling with ammonium chloride, when pure gallium hydroxide is precipitated. When zinc is present neither of the above methods

is available. In this case the metals are precipitated together as ferrocyanides which are dissolved in sodium hydroxide, and the hydroxide precipitated by carbon dioxide. The hydroxides are dissolved in hydrochloric acid, and the gallium precipitated by boiling with ammonium hydrogen sulphite. Alternatively, the alkaline solution of the ferrocyanides is treated with hydrogen sulphide, which precipitates the zinc, the gallium then being obtained by either of the methods described above. J. F. S.

Reaction of Manganese Salts. V. MACRI (*Ann. Chim. anal.*, 1921, [ii], **3**, 55—56).—The author has described previously (A., 1917, ii, 511) the oxalate reaction for manganese as given by Caron and Raquet (A., 1919, ii, 351) and by Denigès (A., 1920, ii, 558). W. P. S.

The Interference of Phosphates in the Detection of Manganese and its Avoidance. TH. SABALITSCHKA and H. NIESEMANN (*Ber. deut. Pharm. Ges.*, 1921, **31**, 30—36. Compare A., 1921, ii, 134).—The failure to detect manganese in presence of an excess of barium or strontium phosphate, when the separation of phosphoric acid is conducted according to Schmidt's analytical scheme, is obviated by the following procedure: The precipitate obtained with ammonium sulphide is dissolved in 5% hydrochloric acid and filtered from insoluble nickel and cobalt sulphides. The solution is then evaporated with 2—3 grams of concentrated sulphuric acid and a like quantity of saturated potassium sulphate solution until white fumes are evolved, any ferrous iron being previously oxidised by nitric acid. The mixed sulphates obtained are extracted with alcohol to remove sulphuric and phosphoric acids (small quantities of manganese and zinc sulphates and most of the chromium also pass into solution). The residue insoluble in alcohol is extracted with dilute hydrochloric acid and the insoluble sulphates of barium, strontium, and calcium are filtered off. From the filtrate iron, aluminum, and chronium are precipitated with ammonia, and then the sulphides of zinc and manganese with ammonium sulphide. The final filtrate contains calcium and magnesium. G. F. M.

The Sodium Acetate Method for the Separation of the Bivalent Metals from the Tervalent Metals in the Ammonium Sulphide Group. TH. SABALITSCHKA (*Ber. deut. Pharm. Ges.*, 1921, **31**, 36—37. The sodium acetate method described by Macri (A., 1920, ii, 699) for the separation of iron, aluminium, and chromium from zinc, manganese, etc., is useless in presence of chromium, as this metal is not precipitated at all when alone, and only partly in the presence of iron or aluminium.
G. F. M.

Use of Spot Reactions in Qualitative Analysis. FRIEDRICH FEIGL and ROSA STERN (*Zeitsch. anal. Chem.*, 1921, **60**, 1—43). —A description of the application of spot reactions on filter-paper

to the detection of numerous substances, especially in mixtures. Special mention is made of the reactions of aluminium, uranium, and chromium with alizarin colouring matters, and of manganese with benzidine. W. P. S.

Estimation of Small Quantities of Chromium in Steels. B. S. EVANS (*Analyst*, 1921, **46**, 38—42).—Four grams of the sample are dissolved in 30 c.c. of dilute sulphuric acid (1 : 3) and 20 c.c. of water, 10 c.c. of nitric acid are then added, and the solution is boiled to expel nitrous fumes. After the addition of 25 grams of ammonium phosphate and 250 c.c. of water, the solution is boiled, treated with a slight excess of permanganate, boiled for a further fifteen minutes, and poured into 120 c.c. of 20% sodium hydroxide solution boiled previously with the addition of a slight excess of permanganate and then treated with 10 c.c. of 5% manganese sulphate solution; if the resulting mixture is not alkaline, more sodium hydroxide is added. After cooling, the mixture is acidified with acetic acid, diluted to 500 c.c., and filtered. If cobalt and nickel are absent, the chromium is estimated colorimetrically by comparison with potassium bichromate solution. When cobalt and nickel are present, 100 c.c. of the filtrate are boiled, sodium hydroxide is added until a precipitate forms, the solution is then cooled, filtered, the filtrate acidified with sulphuric acid, and the chromium estimated colorimetrically.
W. P. S.

Qualitative Separation and Detection of Uranium, Vanadium, and Chromium when Present Together. PHILIP E. BROWNING (*J. Amer. Chem. Soc.*, 1921, **43**, 114—115).—The solution containing chromic and vanadic acids together with a uranium salt is made faintly alkaline with ammonia and then faintly acid with acetic acid and treated with ammonium phosphate. Uranium phosphate is precipitated, filtered, and washed. The uranium is confirmed by the addition to the precipitate of a drop of potassium ferrocyanide, when a reddish-brown stain is the result. The filtrate is treated with sulphur dioxide in excess to reduce the vanadic and chromic acids; the excess of sulphur dioxide is removed by boiling. Bromine is added in excess and the excess removed by boiling, this oxidises the vanadium to vanadic acid but does not affect the chromium. Ammonia is added and the chromium thrown out as a green precipitate of phosphate and hydroxide. After the removal of the chromium, the filtrate is made alkaline with ammonia and saturated with hydrogen sulphide, which gives the pink or violet oxysulphide of vanadium. J. F. S.

Tervalent Titanium. I. Volumetric Estimation of Iron by Titanous Salts. WILLIAM M. THORNTON, JUN., and JAMES E. CHAPMAN (*J. Amer. Chem. Soc.*, 1921, **43**, 91—102).—The method of estimating ferric iron by titration with a solution of titanous chloride, using ammonium thiocyanate as indicator (Knecht and Hibbert, A., 1903, ii, 509), has been investigated and the definite conditions specified for the accurate performance of the operation.

It is shown that either titanous chloride or titanous sulphate in slightly acid solution (to prevent hydrolysis) may be employed. The titanous solution must be kept in contact with hydrogen both in the storage bottle and in the burette, and the titration must be carried out in an atmosphere of carbon dioxide. The titanous solution is standardised by means of ferrous ammonium sulphate, which is oxidised exactly to the ferric condition by potassium permanganate. The titrations should be carried out at temperatures below 30°, and the volume of the solution titrated should in no circumstances exceed 500 c.c. For a satisfactory end point the quantity of indicator used should be, unless there is any special reason to the contrary, 10 c.c. of 10% ammonium thiocyanate, and in no case should less than 2·5 c.c. be used. The presence of hydrochloric acid has no effect on the reaction, but if hydrofluoric acid is present the thiocyanate produces only a yellow coloration instead of a red one. This difficulty is surmounted by the addition of a quantity of boric acid sufficient to restore the red colour. When ferrous iron has to be estimated this should be oxidised to the ferric condition and then reduced with the titanous solution. Solutions of titanous sulphate when preserved in hydrogen maintain their titre unchanged indefinitely.

J. F. S.

Method of Estimating and Verifying the Purity of Organic Compounds by Oxidation with Chromic Acid. H. CORDEBARD (*Ann. Chim. anal.*, 1921, [ii], **3**, 49—53).—The substance is heated with sulphuric acid and a definite excess of potassium dichromate solution, and the excess of dichromate is then titrated with ammonium ferrous sulphate solution. The purity of the substance is deduced from the amount of dichromate which it reduces.

W. P. S.

Critical Temperature of Solution of Hydrocarbons in Aniline and its Application to the Analysis of Light Petroleums. N. CHERCHEFFSKY (*Ann. Chim. anal.*, 1921, [ii], **3**, 53—55).—Priority is claimed (compare A., 1910, ii, 660) as regards the method described by Chavanne and Simon (A., 1919, ii, 432, 433).

W. P. S.

Estimation of Aromatic Hydrocarbons in Mixtures of Hydrocarbons. H. T. TIZARD and A. G. MARSHALL (*J. Soc. Chem. Ind.*, 1921, **40**, 20—25T).—The method proposed depends on the determination of the "aniline point" of the mixture before and after treatment with 98% sulphuric acid; the "aniline point" is the temperature at which a mixture of equal volumes of the hydrocarbon and aniline separates into two layers when cooled down from a temperature at which it is homogeneous. The sample is shaken for thirty minutes with three times its volume of 98% sulphuric acid, the residual hydrocarbon then separated, washed, dried over calcium chloride, and its "aniline point" determined. The difference between this value and that found for the sample before

sulphonation gives directly the percentage of aromatic hydrocarbons in the mixture, that is, lowering of the "aniline point" in degrees Centigrade corresponds with the percentage of aromatic hydrocarbons present. The nature of the non-aromatic hydrocarbon is without effect on the results obtained, but unsaturated hydrocarbons must not be present. W. P. S.

Detection of Methyl Alcohol in Spirits. F. HAHN (*Pharm. Zeit.*, 1921, **66**, 134—135).—The fact that the presence of hydrochloric acid interferes with the sensitiveness of the morphine–sulphuric acid reagent used for the detection of formaldehyde resulting from the oxidation of methyl alcohol, as mentioned by Rabe (this vol., ii, 220), has been known for some time; morphine sulphate, and not the hydrochloride, should be used in preparing the reagent. . W. P. S.

Detection of Methyl Alcohol in Spirits. F. RABE (*Pharm. Zeit.*, 1921, **66**, 135).—A reply to Maue (this vol., ii, 220); the author is quite aware that the resorcinol–sulphuric acid test is not new, but he recommended it as a useful confirmatory test for formaldehyde. W. P. S.

Detection of Methyl Alcohol. G. MAUE (*Pharm. Zeit.*, 1921, **66**, 169).—A reply to Rabe (this vol., ii, 220; preceding abstract). Under definite conditions and in the presence of excess of hydrochloric acid, the magenta–sulphurous acid reaction is characteristic of formaldehyde. W. P. S.

Analysis of Liquid and Gaseous Mixtures of Ether, Alcohol, and Water. IRVINE MASSON and T. LAWSON MCEWAN (*J. Soc. Chem. Ind.*, 1921, **40**, 29—32T).—Fleischer and Frank (A., 1907, ii, 655) have given an approximate method for the analysis of a mixture of water, ethyl alcohol, and ethyl ether, the sample being shaken with water and paraffin ("benzin"), and the increase in volume of the oil being taken as the volume of ether present. This method involves the two assumptions, that all the ether is extracted by the oil, and that no change in volume takes place when ether is mixed with aqueous alcohol. The authors find that neither of these assumptions is correct, the results actually obtained being inaccurate by about 10% for the ether and by considerably more than this for the alcohol.

If, however, the extraction is effected by means of paraffin and water, and due allowance is made for the partition of ether and alcohol between the two layers, the ether content of a sample may be found accurately to within 1%. Further, if this result and the density of the sample are compared with actual experimental data for the densities of synthetic tertiary mixtures, the alcohol content may be estimated to within 1%.

With vaporous mixtures, similar principles apply to the estimation of the ether, the vapours being first absorbed in concentrated sulphuric acid; the alcohol + water are given by difference from

the increase in weight of the acid. The water vapour may be estimated separately, if required, by absorbing it in ignited alumina.
T. H. P.

Characteristic Reaction of Phenol. GEORGES RODILLON (*J. Pharm. Chim.*, 1921, [vii], **23**, 136—137).—If 10 c.c. of a solution containing phenol are treated with a drop of 10% sodium nitrite solution and then poured on the surface of concentrated sulphuric acid, a coloured zone (red above, green below) appears at the junction of the two liquids. W. P. S.

Miscibility of Phenol and some Mineral Solutions. Analytical Applications. RENÉ DUBRISAY (*Bull. Soc. chim.*, 1921, [iv], **29**, 78—88).—A more detailed account of work already published (A., 1919, i, 73; ii, 78; 1920, ii, 508, 756). W. G.

ββ'-Di-iododiethyl Sulphide and its Application to the Detection and Estimation of Yperite. V. GRIGNARD, G. RIVAT, and G. SCATCHARD (*Ann. Chim.*, 1921 [ix], **15**, 5—18).—ββ'-Dichlorodiethyl sulphide in acetic acid solution readily reacts with hydriodic acid to give *ββ'-di-iododiethyl sulphide*, $S(C_2H_4I)_2$, m. p. 62°. The ready formation of this compound may be made use of for the estimation of ββ'-dihydroxydiethyl sulphide or of yperite.

In the estimation of ββ'-dihydroxydiethyl sulphide 0·7—0·8 gram of this substance is weighed out into a 50 c.c. conical flask, 5 c.c. of 54—55% hydriodic acid are added, and the mixture is heated at 70—75° for fifteen to twenty minutes. The mixture is cooled, filtered through glass wool, the precipitate being washed with water. In the filtrate the free iodine is estimated by titration with N/10-thiosulphate and then the acidity with N-sodium hydroxide, using phenolphthalein as an indicator. If these two titrations give B c.c. and A c.c. respectively, and a blank estimation without any hydroxyethyl sulphide gives B_0 c.c. and A_0 c.c., then the weight of dihydroxydiethyl sulphide in the sample weighed out is $61[A_0 - A - (B - B_0)/20]$ mg.

In the estimation of yperite 5 c.c. of 54% hydriodic acid and 15 c.c. of acetic acid are heated at 70° for fifteen minutes under an air condenser, and the mixture is then cooled and made up to 500 c.c. In 50 c.c. of this solution the iodine is liberated by the addition of 10 c.c. of a 10% solution of sodium nitrite. The iodine is extracted with carbon tetrachloride, the extract is washed with water, and the free iodine in it titrated with N/10-thiosulphate, A_0 c.c. being required.

A second operation is carried out, 1 gram of yperite being heated, this time with the hydriodic and acetic acids, but before making the volume up to 500 c.c., 100 c.c. of carbon tetrachloride is added. The mixture is vigorously shaken, and the two layers are then allowed to separate. From the aqueous layer (400 c.c.) 50 c.c. is taken and titrated with N/10-thiosulphate, A_1 c.c. being required. The 100 c.c. of carbon tetrachloride is now carefully separated,

and the free iodine in it is titrated with the $N/10$-thiosulphate, A_2 c.c. being required. Then, if exactly P gram of yperite was weighed out, the sample contained $[10A_0 + 1{\cdot}5 - 8A_1 - A_2]0{\cdot}82/P$ % of yperite.

For the detection of yperite a solution containing 20 grams of sodium iodide, 40 drops of a 7·5% solution of copper sulphate, and 2 c.c. of a 35% solution of gum arabic in 200 c.c. is used. To 4 c.c. of the yperite solution 1 c.c. of this reagent is added, and a turbidity is produced after an interval of time varying with the temperature and the dilution of the yperite solution. In this way it is possible to detect 0·05 gram of yperite per cub. metre of air, after bubbling the air slowly through the reagent. W. G.

New Method for the Volumetric Estimation of Reducing Sugars. AL. IONESCU and V. VARGOLICI (*Bul. Soc. Chim. România*, 1920, **2**, 38—45).—The solution recommended contains 46 grams of potassium ferricyanide and 46 grams of potassium hydroxide in 1 litre. For an estimation, 10 c.c. of this solution is diluted with 20 c.c. of water and heated to boiling, and the sugar solution run in drop by drop until the colour just disappears. The end-point is made clearer if 10 drops of a 1% solution of picric acid are added. The latter reagent in alkaline solution in the presence of a reducing agent is converted into red picramic acid. In estimating sugar in urine, more accurate results are obtained if the urine is first defecated with lead acetate, the lead being subsequently precipitated with sodium carbonate. For the estimation of lactose in milk, the milk is first clarified by means of a 1% solution of picric acid in 2% acetic acid. In all these estimations the concentration of the sugar solution should not exceed 1%. The ferricyanide solution should be standardised against pure dextrose and 10 c.c. should be equal to 0·05 gram of dextrose.

W. G.

Quantitative Estimation of Blood Sugar with the Aid of Methylene-blue. W. EISENHARDT (*Münch. Med. Woch.*, 1920, **67**, 1382—1383; from *Chem. Zentr.*, 1921, ii, 343).—The process depends on the observation of Williamson (*Brit. Med. Journ.*, 1896) that decolorisation occurs within a few minutes when 40 c.c. of blood of a diabetic patient is heated with alkaline methylene-blue solution (1 : 6000) on the water-bath, whilst about three times this amount of normal blood is necessary to produce the same effect. An estimate of the amount of reducing substances can be formed if diminishing quantities of blood or serum are heated with methylene-blue in alkaline solution and the limits of the change of colour are observed. H. W.

Bang's Micromethod for the Estimation of Dextrose. SVEND AAGE HOLBØLL (*Biochem. Zeitsch.*, 1921, **113**, 200—209).—According to the author, 0·265 c.c. of 1/100 potassium iodate corresponds with 0·1 mg. of dextrose in Bang's new micromethod. It is also advisable to boil for six minutes in order to obtain the best results. S. S. Z.

Volumetric Method for the Estimation of Lactose by Alkaline Potassium Permanganate. FELIPE T. ADRIANO (*Philippine J. Sci.*, 1920, **17**, 213—220).—A mixture of 50 c.c. of N/10-permanganate solution, 25 c.c. of 0·848% sodium carbonate solution, 10 c.c. of lactose solution (containing about 1·5 % of the sugar) and 15 c.c. of water is heated at 95° for two minutes, 25 c.c. of 30% sulphuric acid are then added, and the mixture is titrated with N/10-oxalic acid solution until the liquid is clear. The excess of oxalic acid is titrated with N/10-permanganate solution. The quantity of permanganate used for the oxidation is a measure of the amount of lactose present; the permanganate solution must be standardised against pure lactose. A table is given showing the amounts of permanganate corresponding with quantities of lactose varying from 1 to 40 mg. The method may be applied to the estimation of lactose in milk after this has been treated with copper sulphate, nearly neutralised, and filtered; the results obtained are slightly lower than those yielded by the Soxhlet method. W. P. S.

Reagent for Wood and Vanillin. J. GRÜSS (*Ber. Deut. bot. Ges.*, 1921, **38**, 361—368).—The reagent is prepared by dissolving vanadium pentoxide in dilute phosphoric acid solution. When a wood shaving is treated with this solution, the cell walls are gradually coloured yellowish-brown. A reddish-brown precipitate is produced when vanillin is added to the reagent; if the test is made on a microscope slide, the formation of red-brown crystals may be observed. W. P. S.

The Estimation of Bile Acids in Bile. CARL L. A. SCHMIDT and A. E. DART (*J. Biol. Chem.*, 1921, **45**, 415—421).—Hydrolysis of the bile acids with sodium hydroxide yields glycine and taurine, which can be estimated together by the reaction of their amino-groups with nitrous acid. Taurine can be estimated separately by an analysis of the sulphur, and from these two determinations the amounts of glycocholic and taurocholic acids may be estimated. J. C. D.

Detection of Acetone in Urine. H. CITRON (*Deut. med. Woch*,. 1920, **46**, 1439; from *Chem. Zentr.*, 1921, ii, 432—433).—The apparatus recommended for the distillation of acetone from the urine under investigation, consists of a glass bulb of about 250 c.c. capacity, open at the top and drawn out at the bottom to a solid rod to which a small, saucer-like cup is fixed. In use, urine (50 c.c.) is placed in a beaker immersed in water heated previously to its boiling point; the bulb is filled with cold water, and placed on the beaker, the contents of which are boiled during three minutes. The distillate collects in the little cup and is tested for acetone in the usual manner. H. W.

General and Physical Chemistry.

The Law of Moduli and the Theory of Electrolytic Dissociation. Determination of Moduli of Refraction. VICTOR J. BERNAOLA (*Anal. Soc. Quim. Argentina*, 1920, **8**, 17—31 and 73—99).—An exposition of Valson's law of moduli applied to solutions of electrolytes is given with special reference to earlier work on indices of refraction and refractive powers. The earlier observations have been supplemented by the author, using normal and decinormal solutions at 20° and 30° respectively. Moduli of refraction have been calculated for a number of kations and anions both in normal and decinormal solutions. It is shown that the temperature effect is negligible. Whilst refractive indices of solutions calculated from the moduli obtained are in good agreement with observed values when only normal or decinormal solutions are considered, the moduli obtained from the observations on normal solutions do not give satisfactory results when used for the calculation of refractive indices of decinormal solutions and vice versa. G. W. R.

Dispersion of Hydrogen in the Ultra-violet. MAX KIRN (*Ann. Physik*, 1921, **64**, 566—576).—The refractive index of hydrogen for the green mercury line $\lambda 5462$ was determined absolutely: $(n-1).10^6 = 139{\cdot}65$. The dispersion was measured to $\lambda 1854$ and can be represented by the formula $(n-1).10^8 = 13610{\cdot}1866 + 1{\cdot}0246373 \times 10^{10}\lambda^{-2} + 990606{\cdot}9 \times 10^{10}\lambda^{-4} + 70{\cdot}512617 \times 10^{20}\lambda^{-6}$. The value of $n-1$ increases more rapidly with λ than according to Debye's formula. J. R. P.

The Spectrum of Hydrogen Positive Rays. L. VEGARD (*Phil. Mag.*, 1921, [vi], **41**, 558—566).—The differences found by Thompson (see A., 1920, ii, 521) in the spectra of hydrogen positive rays are ascribed to chance variations in pressure and the energy of the rays. Light is emitted both when the positively charged atom is neutralised and when the neutral atom collides with the molecules of the gas. J. R. P.

The Spectrum of Hydrogen Positive Rays. G. P. THOMPSON (*Phil. Mag.*, 1921, [vi], **41**, 566—567).—A reply to the criticism of Vegard (see preceding abstract). The latter does not explain the correlation shown to exist between the ratio of the intensities of the spectra and the proportion between the atoms and molecules of hydrogen in the rays as determined directly. J. R. P.

The Vacuum Arc Spectra of Sodium and Potassium. SNEHAMOY DATTA (*Proc. Roy. Soc.*, 1921, A., **99**, 69—77).—The wave-lengths of the sharp and diffuse series of lines of sodium

and potassium were measured in a source giving well-defined lines. Channelled-space emission bands were observed in the light from a sodium vapour lamp and their heads measured approximately. The combination line $1s - 2d$ in potassium has been resolved into a pair, the wave-lengths of which were measured. The presence of potassium in the sun was established and some additional sodium lines were identified with solar lines. J. R. P.

Some Spark Spectra in the Extreme Ultra-violet. LÉON BLOCH and EUGÈNE BLOCH (*Compt. rend.*, 1921, **172**, 803—805).—The spark spectra are given for zinc over the range $\lambda = 1840$ to 1440, for cadmium over the range $\lambda = 1850$ to 1420, and for lead over the range $\lambda = 1822$ to 1406. W. G.

The Spark Spectra of Iron and Cobalt in the Extreme Ultra-violet. LÉON BLOCH and EUGÈNE BLOCH (*Compt. rend.*, 1921, **172**, 851—854).—The spark spectra of iron over the range $\lambda 1845$ to 1530 and of cobalt over the range $\lambda 1845$ to 1455 are given. The rays are generally weak; many are classed as diffuse or broad and many are probably double or multiple. W. G.

Rotation Spectra and Isotopy. ARTHUR HAAS (*Zeitsch. Physik*, 1921, **4**, 68—72).—A theoretical paper in which the rotation spectrum is discussed and it is shown that the three different forms of the rotation spectrum, the pure rotation spectrum, the vibrational rotation spectrum, and the band spectrum are to be represented by the equations (i) $\nu = \gamma/J$, (ii) $\nu - \nu_0 = \gamma/J$, and (iii) $\nu - \nu_0 = \gamma_1/J_1 - \gamma_2/J_2$ in which J_1 and J_2 are the moment of inertia before and after electron transference, ν_0 the fundamental frequency, and γ, γ_1, and γ_2 quantities dependent on the quantum number. Hence with a given quantum number and a given fundamental frequency the vibration number is a function of the molecular moment of inertia alone, from which it appears possible to obtain spectroscopic evidence of isotopy. J. F. S.

Functions of Chromophores. VII. Optical Properties of some Heavy Metal Complexes. II. I. LIFSCHITZ and ERNST ROSENBOHM (*Zeitsch. physikal. Chem.*, 1921, **97**, 1—14. Compare A., 1920, ii, 208).—The absorption spectra of a number of derivatives of cobalt, chromium, manganese, iron, osmium, platinum, rhodium, and several organic substances has been investigated. The spectra obtained from solutions exhibit similar wide, flat, and somewhat diffuse bands which are in all probability made up of a series of narrow, sharper bands. To test this point, the absorption spectra of the vapour of osmium tetroxide, the triacetylacetonates of cobalt, chromium, and iron, nickel carbonyl, quinone, and ferric chloride were examined. It is found that only in the case of osmium tetroxide and benzoquinone was the desired spectrum observed, in the former case twelve bands between $\lambda 2313{\cdot}2$ and $\lambda 3111{\cdot}9$ were observed, whilst in the latter case nine bands between $\lambda 4030$ and $\lambda 4769$ were obtained. In the case of benzoquinone the bands form a series which is represented by the formula

$\nu = 2096{\cdot}9 + 35{\cdot}4n + 1{\cdot}3m$, where n is a whole number lying between 3 and 10, and m one of the whole numbers, 0, 6, 4, 9, 11, 15, and 23. J. F. S.

Functions of Chromophores. VIII. Chromophores of Conjugated Compounds. I. LIFSCHITZ (*Zeitsch. physikal. Chem.*, 1921, **97**, 15—21. See preceding abstract).—A discussion of Ley's remarks on the constitution of conjugated salts of 1—3 diketones (A., 1920, ii, 571). J. F. S.

Absorption Spectra of Potassium Ferro- and Ferri-cyanides. FREDERICK H. GETMAN (*J. Physical Chem.*, 1921, **25**, 147—159).—The absorption spectra of the α- and β-ferrocyanides of potassium are identical, which is in favour of the non-isomeric character of these salts. A slight but well-defined difference between the absorption spectra of the α- and β-ferricyanides of potassium was established, confirming the isomeric character of the salts. There is a marked difference between the absorption spectra of ferrocyanides and ferricyanides of potassium. On the assumption that an absorption band indicates potential tautomerism in the molecule, a modification of the formulæ proposed by Friend (T., 1916, **109**, 718) offers a possible explanation of the presence of bands in the absorption spectra. The relative number and position of the tautomeric groups may be the cause of the marked differences between the absorption spectra of ferro- and ferri-cyanides of potassium. J. R. P.

The Absorption of Light by Reduced Hæmoglobin. PAUL HÁRI (*Biochem. Zeitsch.*, 1921, **115**, 52—62).—The absorption of light by reduced hæmoglobin has been determined along a large part of the visible spectrum. The maximum absorption occurs at $555{\cdot}3\mu\mu$. S. S. Z.

Spectrophotometry in the Visible and Ultra-violet Spectrum. T. R. MERTON (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 78—84).—The dispersing system (for example, prism) is crossed with a very coarse grating and the length of the slit reduced to a very small value. The grating is inserted between the prism and the camera lens with the rulings perpendicular to the refracting edge of the prism. A continuous spectrum then appears on the plate as a dark central strip with a succession of other strips of different intensities on each side. In the case of a discontinuous spectrum, the "lines" consist of dots of different intensities on each side of the central dot. If the last dots visible in the case of two lines are noted, previous knowledge of the relative intensities of the different orders corresponding with these dots enables the relative intensities of the lines to be determined. The gratings were constructed by ruling a smoked quartz plate and calibrated with a neutral wedge. J. R. P.

Polarisation and Intensity of the Fluorescence of Iodine Vapour and its Dependence on Temperature. PETER PRINGSHEIM (*Zeitsch. Physik*, 1921, **4**, 52—60).—The partial polarisation

of the fluorescence of iodine vapour is within the temperature range 20—350° independent of the temperature; this fact, despite the increase in the velocity of rotation of the molecule, is to be expected on theoretical grounds. The intensity of the fluorescence on warming over the temperature range 20—350° decreases only slightly, the relative values being 20°, 100; 100°, 99; 200°, 97·5; 300°, 94·5; and 350°, 92·4. Thus the weakening of the fluorescence by increasing the vapour density is not to be explained by the shortening of the mean impact time alone. J. F. S.

The Influence of Light on the Conductivity of Fluorescent Liquids. H. SOULAN (*Compt. rend.*, 1921, **172**, 581—582).—The prolonged illumination of a fluorescent liquid results in a progressive variation of the electrical conductivity, ending in the establishing of a limit value, which should remain after return to darkness. The results with a number of fluorescent substances in very dilute solutions give the equation $\log (C_\infty - C_t) = b - at$, C_t being the conductivity at a time t, C_∞ the limit value, and a and b two constants characteristic of the fluorogen. W. G.

Colour and Optical Activity in Organic Compounds. ERNESTO LONGOBARDI (*Anal. Soc. Quím. Argentina*, 1920, **8**, 153—161).—The possibility of an antagonism between optical activity and colour in organic compounds was suggested in an earlier paper by the author (A., 1913, ii, 368). This question is discussed further in the present paper. Coloured compounds exist which, from their structure, should exhibit optical activity. Where optical activity has been verified, certain anomalies occur and, further, the materials used have been of doubtful purity. Unsuccessful attempts were made by the author to resolve alkali-blue and nitrotyrosine, obtained from *l*-tyrosine. G. W. R.

Photolysis of Water. EMIL BAUR and A. REBMANN (*Helv. Chim. Acta*, 1921, **4**, 256—262).—The fact that, when two unattackable electrodes are polarised in the solutions of certain colouring matters sensitive to light and then illuminated, alterations of potential occur at the electrodes and consequently depolarisation currents are originated, is best explained on the assumption that the colouring matter produces a photochemical decomposition of the water, but to such a slight extent that no visible evolution of detonating gas takes place (compare Staehelin, A., 1920, ii, 580). The authors experimented with solutions of uranyl salts, eosin, rhodamine, quinine, etc., in an exhausted vessel with the help of the differential tensimeter, but no sign of the evolution of oxygen or hydrogen was observed. The use of depolarisers also led to no definite result. The apparent rarity of chemical light actions is conditioned by the fact that the primary products of photolysis are usually capable, either by a reaction in the dark or by a second photolytic process opposed to the first, of re-forming the original compounds; the total chemical effect of the light is thus nil. The results obtained show that it is difficult to break into such a reaction cycle by addition of depolarising agents. T. H. P.

Primary Effect of Light and Photochemical Valency. P. R. Kögel (*Photogr. Korr.*, 1920, **57**, 308—310; from *Chem. Zentr.*, 1921, i, 553).—The primary photochemical effect consists in the activation of additional valency, which is only possible when energy is supplied, and leads first of all chemically to the formation of additive compounds. The effect of a photochemical catalyst is similar, and can hence lead to the formation of an endo-energetic product, the catalyst reverting to its original state of energy. Such an action can be attributed to chlorophyll. Other photochemical reactions can be attributed to the formation or breaking up of polymerides. Photostereochemical grouping is also closely related. The activation of silver bromide by dyes can be explained as follows. The light raises the valency of single atoms in the dye molecule; the bromine will not be set free from the silver by the partly actinic rays, for example, yellow, but its union will be loosened; the bromine will then tend to react with the additional valency of the dye, without, however, a compound necessarily being formed. The dye, as is already believed, only acts catalytically. G. W. R.

Optical Properties of Disperse Systems. I. Colour Changes through Illumination. Fritz Weigert (*Kolloid Zeitsch.*, 1921, **28**, 115—124).—When silver chloride gelatin emulsion, which has been exposed to light until a bluish-red colour is produced and then washed to remove excess of silver nitrate, is exposed to light of various colours, the emulsion assumes approximately the colour of the exciting light. In all cases the extinction in the existing colour is decreased by the treatment, but in all other colours it is increased. The change is shown to be entirely physical, due to a change in the silver chloride–silver system. When the exciting light is linearly polarised, the isotropic layer assumes the properties of double refracting crystals, the extinction direction of which lies in the intersecting line of the vibration plane of the electrical and magnetic vector of the exciting radiation with the layer. When the exciting light is first applied the layer is positively dichroic in all colours other than the exciting colour; when the treatment is long the dichroism changes its sign. The effect of light weakens with decreasing wave-length, particularly in the case of the double refraction and the dichroism. The extinction is equally strong in the green and blue and decreases from yellow to the red, so that the colour of the layers is always red. The sensitiveness does not run parallel with the extinction; the maximum in this case lies in the red. It is shown that the above phenomena occur also in other cases. Collodion layers of the cyanine dyes are the most sensitive, but collodion layers of most sensitising dyes, such as pinachrome, pinacyanol, pinaverdol, orthochrome, homocoll, and ethyl-red also exhibit the same phenomena.

J. F. S.

Action of Light on Silver Bromide. I. Walther Ehlers and Peter Paul Koch (*Zeitsch. Physik*, 1920, **3**, 169—174).—With the object of ascertaining the course of the action of light on

silver bromide, the authors have determined the change in weight which occurs when particles of silver bromide of an average diameter 0·4μ are illuminated. The method consisted in placing particles of silver bromide in a condenser and determining the potential which must be applied to keep the particle suspended. A beam of light is then allowed to fall on the bromide and the change in the potential ascertained at intervals of time. It is found that when the condenser is filled with air the mass of the particles increases slightly by an amount corresponding with an increase in potential of 1·5 volts; on the other hand, if the condenser is filled with nitrogen, it is found that with larger particles the weight decreases 1·5—5·0%, whilst with the smallest particles the decrease is 10%. From these data it becomes possible to calculate the mass of the latent image, and the amount of bromine given up by the particles on illumination. Calculations show that a particle of silver bromide of weight 3×10^{-12} gram loses, on illumination for twenty minutes by an arc lamp, 6% of its weight of bromine. Comparative experiments with a specially rapid silver bromide gelatin plate show that the bromide particle, when illuminated for 1/100 sec. by a light intensity 1/10000 of that used in the above experiments, loses $1·5 \times 10^{-22}$ gram of bromine, that is, approximately one atom per particle. J. F. S.

Optical Properties of Disperse Systems. II. Significance of the Amicroscopic Phase. FRITZ WEIGERT and HANS POHLE (*Kolloid Zeitsch.*, 1921, **28**, 153—161. Compare this vol., ii, 289).—A continuation of work previously published (*loc. cit.*) undertaken with the object of ascertaining whether the ultramicroscopic examination of changes which occur when photo-sensitive chlorides are exposed to light is capable of furnishing knowledge of the changes occurring in the individual particles of a colloidal system. The results, as far as the main object of the work is concerned, are negative, since it is shown that the secondary particles, which alone are responsible for the change, are not resolvable ultramicroscopically. The absorption displacement and the dichroic effect brought about by light is due to the action on the amicrons of the light-sensitive chlorides which are closer together than the wave-length of the exciting light. It is calculated that the portion of the photo-chloride which is affected by these optical amicrons amounts to at least 36%. It is shown that the optical properties of the system are due to amicroscopic micellæ which are nearer together than the wave-length of the light used.
J. F. S.

The Influence of Light Energy on the so-called Exchange or Displacement Reactions. Reduction of Alkali Nitrite. OSKAR BAUDISCH (*Ber.*, 1921, **54**, [*B*], 413—417).—Reactions of the type of the reduction of nitrite by potassium ferrocyanide and oxygen (A., 1917, i, 434) are found to be very susceptible to the influence of light. Thus, a freshly-prepared-solution of potassium ferrocyanide is unchanged by a solution of nitrosobenzene or *p*-nitrosodimethylaniline in the dark, but rapidly darkens in colour

on exposure to light owing to the formation of the compounds $\left[Fe\begin{smallmatrix}Ph\cdot NO\\(CN)_5\end{smallmatrix}\right]Na_3$ and $\left[Fe\begin{smallmatrix}NMe_2\cdot C_6H_4\cdot NO\\(CN)_5\end{smallmatrix}\right]Na_3$. The newly-introduced group can be again displaced if an excess of sodium cyanide or sodium nitrite is added to the solutions which are kept exposed to light. Similarly, one cyano-group of potassium ferrocyanide is readily displaced by oxygen, with the formation of an intensely yellow peroxide, $\left[Fe\begin{smallmatrix}O_2\\(CN)_5\end{smallmatrix}\right]K_3$, when aqueous solutions are exposed to light and air, and the compounds, $\left[Fe\begin{smallmatrix}NH_3\\(CN)_5\end{smallmatrix}\right]Na_3$ and $\left[Fe\begin{smallmatrix}OH_2\\(CN)_5\end{smallmatrix}\right]Na_3$, are autoxidisable with still greater ease.

The following experiments are designed to show that subsidiary valencies are operative in these exchange reactions. Among organic compounds, pyridine has the greatest affinity for iron, union occurring with the iron atom by means of the subsidiary valency of the tervalent nitrogen atom. If this is actually the case, 2-methylpyridine must be considerably less active, since its subsidiary nitrogen valency is partly diverted by the neighbouring methyl group. This is shown to be the case by mixing solutions of $\left[Fe\begin{smallmatrix}NH_3\\(CN)_5\end{smallmatrix}\right]Na_3$ with pyridine and α-picoline and adding aqueous alcoholic solutions of nitrosobenzene. In the absence of base, an intense violet colour is immediately developed; with pyridine, the nearly colourless solution gradually becomes pink, whilst with α-picoline an intense wine-red colour is produced which becomes as dark violet as the control solution. The percentage of pyridine in technical α-picoline can be estimated approximately in this manner. H. W.

Photo-bromination of Toluene and Xylene. TORSTEN SWENSSON (*Zeitsch. wiss. Photochem.*, 1921, **20**, 206—218).—The rate of absorption of bromine by toluene and xylene in the presence of benzene, alcohol, carbon tetrachloride, or hydrogen bromide, when exposed to light from a quartz mercury lamp at 20°, has been investigated. The results show that alcohol has a negative catalytic action on the process owing to its removal of the hydrogen bromide from the sphere of action. Hydrogen bromide catalyses the reaction very strongly in the positive sense, and at the same time it is decomposed. J. F. S.

Collisions between Atoms and Free Electrons. O. KLEIN and S. ROSSELAND (*Zeitsch. Physik*, 1921, **4**, 46—51).—A theoretical paper in which the effects of collisions between atoms and free electrons are considered. The authors regard such collisions as of two kinds, (1) collisions of the first kind studied by Franck and Hertz (A., 1919, ii, 206) in which a change of the atomic system, without the emission of rays, from the normal condition to a stationary condition with greater energy is brought about whilst the electron loses a definite amount of energy in keeping with the energy principle and (2) collisions of the second kind, in which

the atom, without emission of radiation, passes from a stationary condition of greater energy content to a stationary condition of smaller energy content, whilst the electron after the completion of the collision possesses a greater kinetic energy, the amount of the increase being equal to the energy lost by the atom.

J. F. S.

Precision Measurements in the X-Rays Spectra. IV. K. Series, the Elements Copper to Sodium. ELIS HJALMAR (*Phil. Mag.*, 1921, [vi], **41**, 675—681).—See A., 1920, ii, 655.

Fine Structure of the Röntgen Spectra. ADOLF SMEKAL (*Zeitsch. Physik*, 1921, **4**, 26—45).—A theoretical paper in which an attempt is made to extend in two directions the position reached by the Kossel-Sommerfeld considerations of the fine structure of the Röntgen spectra. Kossel and Sommerfeld make use of hydrogen-like energy levels for the individual electron sheaths. The present work subdivides the sheath as a whole into three quantum numbers, and postulates sheath conditions, in which all the electrons do not behave similarly. The first assumption explains satisfactorily all the sheath conditions, including those which are unlike hydrogen, corresponding with the absorption edges of the individual Röntgen series, if none of the quantum numbers can become zero. The second assumption appears to be of importance for the K sheath, and on this basis an explanation of the fine structure of K_α is attempted. It is also shown that the L series contains only three absorption edges, the Λ doublet of the L series is not real, the K_{α_3} and K_{α_4} lines of Siegbahn as well as the K_{α_5} and K_{α_6} lines of Hjalmar have, as has K_α, two quantum levels. J. F. S.

Interpolation Table for the Calculation of Spectral Series. ANGEL DEL CAMPO and MIGUEL CATALÁN (*Anal. Fís. Quím.*, 1920, **18**, 118—128).—Rydberg's tables for the calculation of spectral series are recalculated, using the more recent value for the constant N, found by Curtis (A., 1914, ii, 761). G. W. R.

The Corpuscular Spectra. Laws of the Photo-electric Emission for High Frequencies. MAURICE DE BROGLIE (*Compt. rend.*, 1921, **172**, 806—807. Compare this vol., ii, 232, 323).—In illuminating a certain radiator, A, with a ray of light, X, of frequency ν, the Bohr's rings of the radiator corresponding with the work of extraction W_K, W_L, W_M, etc., for the emission of electrons, a series of corpuscular rays may be observed having for quanta $h\nu - W_K$, $h\nu - W_L$, $h\nu - W_M$, ..., if the frequency ν is superior to the frequency K. The radiator A also gives fluorescent rays which furnish corpuscular rays. W. G.

Relative Ionisation of Different Gases by α-Rays. VIKTOR F. HESS and MARIA HORNYAK (*Wien. Anzeiger*, 1920, 219; from *Chem. Zentr.*, 1921, i, 552—553).—Measurements were made of the total ionisation by α-rays from polonium of carbon dioxide, nitrogen,

oxygen, hydrogen, and coal gas compared with that of air. For carbon dioxide, using the full range of the radiation, it was about 23% greater and for coal gas about 12% less than for air. By restricting the range of the radiation used, that is by using α-rays of smaller velocity, quite different relative values were obtained, from which it is concluded that the form of the Bragg curve is notably different for the different gases, particularly in the terminal portion of the range. For example, using the last three millimetres of the range, the ionisation for carbon dioxide was 8% smaller, for coal gas 22% smaller, but for hydrogen 25% greater than for air. G. W. R.

Disintegration of Atoms by α-Particles. (SIR) E. RUTHERFORD and J. CHADWICK (*Nature*, 1921, **107**, 41).—The hydrogen atoms expelled from a hydrogen compound on bombardment with α-particles have a range of 29 cm. in air; those from nitrogen 40 cm. Long-range hydrogen atoms were similarly liberated from boron, sodium, fluorine, aluminium, and phosphorus. They are not liberated from oxygen, sulphur dioxide, or carbon dioxide molecules. The following elements showed little if any effect with an absorption corresponding with 32 cm. of air: lithium, glucinum, carbon, oxygen, magnesium, silicon, sulphur, chlorine, potassium, calcium, titanium, manganese, iron, copper, tin, and gold. The particles appear to consist of hydrogen liberated at different speeds. Assuming the law connecting range and velocity to be the same as for α-particles, it would appear that the energy of the H-particle from aluminium is about 25% greater than the energy of the incident α-particle. The conclusion is drawn that elements with atomic mass $4n$, where n is a whole number, give no particles, whilst elements with atomic masses $4n+2$ or $4n+3$ give the particles. Atoms of type $4n$ are supposed to be built up of stable helium nuclei; those of masses $4n+2$ or $4n+3$ of helium and hydrogen nuclei. J. R. P.

Different Modes of Radioactive Disintegration and the Possibility of [Indicating] their Significance from the Nuclear Structure. LISE MEITNER (*Zeitsch. Physik*, 1921, **4**, 146—156).—On the basis of the generally accepted helium hydrogen nuclear structure of the atomic nucleus, the author has deduced theoretically four different methods by which radioactive disintegration may proceed. These are (i) a series of successive α-changes, $-\alpha-\alpha-\alpha-$, (ii) an α′-change followed by two β-changes, $-\alpha'-\beta-\beta-$, (iii) a β-change which leads to branch changes leading eventually to the same product, $\beta\text{-}\underset{\alpha'\ \beta}{\overset{\beta\ \alpha'}{<>}}$, and (iv) a branching change of the form $\underset{\alpha'}{\overset{\alpha}{<}}$ or $\underset{\beta}{\overset{\alpha}{<}}$. These four modes of disintegration are considered in connexion with the known radioactive changes. J. F. S.

Mass of the Long-range Particles from Thorium-*C*. (SIR) E. RUTHERFORD (*Phil. Mag.*, 1921, [vi], **41**, 570—574).—In the disintegration of thorium-*C* a small number of particles with the

long range of 11·3 cm. are expelled, which were supposed to be atoms of helium. On account of the possibility that these may have originated by collision of the α-particles with the oxygen of the mica, the experiments were repeated with aluminium as the absorbing screen. The same results were found (see following abstract), the number of particles being 1/10,000 of the total number of α-particles from the thorium-*C*. Examination of the deflection of the particles in a magnetic field showed that they were ordinary α-particles of mass 4. There is no information as to the source of the long-range α-particles. It may be that thorium-*C* may break up in two ways with emission of rays of ranges 8·6 and 11·3 cm., or that 1/10,000 of the atoms of thorium-*C* break up directly with emission of these very swift α-particles. The resulting product would have the atomic number 81, which is that of an isotope of thallium of atomic weight 208. The amount of thallium found in thorium minerals should be about 0·00004%. J. R. P.

Long-range Particles from Thorium Active Deposit. A. B. Wood (*Phil. Mag.*, 1921, [vi], **41**, 575—584; see also preceding abstract).—The emission of long-range particles from thorium active deposit was re-examined. The ratio of the total number of particles with ranges exceeding 8·6 cm. to the total number of ordinary α-particles (ranges 5·0 and 8·6 cm.) is 1 to 11,000. At least 90% of the long-range particles originate in the active deposit, whilst the remainder are probably produced by collision of α-particles with oxygen atoms in the mica screen employed to stop the short-range particles. Slight evidence was obtained of the existence of high-velocity particles, probably hydrogen atoms, of ranges exceeding 11·3 cm. The proportion of these to the total number of long-range particles is probably not more than 1 in 100. J. R. P.

Volatilisation of Thorium-*B* and Thorium-*C* deposited on Gold. Stanislaw Loria (*Krakauer Anzeiger*, 1917, 260—264; from *Chem. Zentr.*, 1921, i, 608).—The volatilisation of a radioactive product deposited on metal was examined in the case of thorium-*B* + thorium-*C* deposited on gold. The volatilisation of thorium-*B* from gold begins sooner than from platinum and palladium and throughout the temperature interval 300—1000° is greater from gold than from the other two metals. The volatilisation of thorium-*C* from gold is very similar to that from platinum. In both cases there occurs a discontinuity on the volatilisation curve at about 760°, which may be referred to the occurrence of thorium-*C* oxide, stable in this region of temperature. This discontinuity is not shown for thorium-*C* on palladium. G. W. R.

The Isotopism of Mesothorium and Radium and the Separation of these Elements from Barium. Ralph K. Strong (*J. Amer. Chem. Soc.*, 1921, **43**, 440—452).—To ascertain whether mesothorium and barium are truly isotopic, experiments were made in which barium compounds from monazite residues, containing mesothorium and radium, were subjected to fractiona-

tion, the ratio of mesothorium to radium being determined both before and after the concentration of the radioactive elements. By fractional crystallisation of the hydroxide, starting with 1,100 grams of barium chloride containing 11 mg. of mesothorium and 3 mg. of radium, there were obtained a rich fraction of 17 grams of barium chloride containing 8·4 mg. of mesothorium, and a poor fraction containing 0·22 mg. in 746 grams. The rich fraction was converted into bromide and by fractional crystallisation, 0·55 gram of crystallised barium bromide was obtained containing 6·4 mg. of mesothorium. The bromide process is much more efficient than the hydroxide process for concentrating the radioactive elements. The ratios of mesothorium to radium in the rich and poor fractions from the hydroxide fractionation and in the rich bromide fraction were found to be identical with the ratio in the original material. Radium and mesothorium are therefore true isotopes. E. H. R.

General System of the Isotopes. A. VAN DEN BROEK (*Physikal. Zeitsch.*, 1921, **22**, 164—170).—A theoretical paper in which the conditions of a schematic representation of the isotopes are discussed. J. F. S.

Absorption of Gases in the Electric Discharge Tube. F. H. NEWMAN (*Proc. Physical Soc.*, 1921, **33**, 73—82).—Various elements were deposited in a pure condition on the cathode in an electric discharge tube. To obtain a clean surface of the element the latter was distilled in a vacuum. An electric discharge was passed through nitrogen contained in the tube. Measurements were made to compare the amount of gas absorbed by the element with the quantity of electricity passing. Potassium, sodium, mercury, cadmium, antimony, magnesium, calcium, zinc, tin, phosphorus, sulphur, and iodine were used. The rates of absorption were very great with the last three elements. Hydrogen was also used in the tube and absorption occurred with phosphorus, sulphur, and iodine. The absorption is attributed principally to chemical action. Nitrogen and hydrogen assume active modifications when exposed to an electrical discharge at low pressure. J. R. P.

Mobility of Ions which are Common with those of the Solvent. G. VON HEVESY (*Zeitsch. Elektrochem.*, 1921, **27**, 21—24).—A theoretical paper in which the abnormally large mobilities of the hydrogen and hydroxyl ions are discussed. It is shown on the basis of Noyes's electrical conductivity measurements that the abnormally high mobilities of the hydrogen- and hydroxyl-ions vanish at high temperatures, and therefrom it follows that the ions of water migrate according to the same laws as other ions. A comparison of the mobility of the hydrogen ion and the hydrogen molecule shows that the latter migrates very rapidly in comparison with the "normal" ions and is only one and a half times slower than the hydrogen ion. This fact is opposed to the hypothesis that the hydrogen- and hydroxyl-ions migrate in a manner different from that of the other ions. The viscosity of water is calculated to 0·001205 at 218° and 0·000927 cg. at 306°. J. F. S.

Chlorine Overvoltages. EDGAR NEWBERY (T., 1921, **119**, 477—486).

Explanation of the Electrical Phenomena during the Decomposition of Ammonium Amalgam. GERTRUD ARONHEIM (*Zeitsch. physikal. Chem.*, 1921, **97**, 95—133).—The expulsion of positive carriers of electricity from the surface of decomposing ammonium amalgam has been examined quantitatively and the process compared with the expulsion of carriers of electricity from the surface of pure mercury when gases are bubbled through it. It is shown that both processes exhibit exactly the same regularities. They give rise to carriers charged in the same sense and have similar pressure and temperature curves. Thus the production of carriers is to be attributed to the same cause in both cases, namely, to the bubbling of gas through an electric double layer (Lenard, A., 1915, ii, 507). It is shown that bubbling ammonia through mercury does not give rise to the charged particles, whilst hydrogen and carbon dioxide produce about the same effect. It is noted that the expulsion of gas from the surface of a liquid ammonium amalgam is not visible even microscopically; this indicates an extremely fine state of subdivision of the gases. See also de Broglie (A., 1907, ii, 664), Coehn (A., 1901, ii, 155), McCoy (A., 1912, i, 539) and Becker (*Ann. Physik*, 1909, **29**, 909).

J. F. S.

Thermo-elements. I. Thermal and Electrical Conductivities of Copper-Phosphorus Alloys. GEORG PFLEIDERER (*Ges. Abhandl. Kennt. Kohle*, 1919, **4**, 409—426; from *Chem. Zentr.*, 1921, i, 348).—The efficiency of the transformation of thermal into electrical energy by means of a thermo-element depends, not only on thermo-electrical power, but also on the ratio of thermal to electrical conductivity: the efficiency of the transformation will be less with increase of this ratio, which, according to the Wiedemann-Franz law, should remain constant.

Experiments on copper-phosphorus alloys containing 1·98 and 0·63% of phosphorus respectively failed to confirm previous observations of favourable variations in the ratio of thermal to electrical conductivity. It is concluded that there is no prospect of obtaining any increase in efficiency of thermo-elements by modification of this ratio.

G. W. R.

Thermo-elements. II. The Thermo-electric Power of Antimony-Cadmium Alloys of about 50 Atomic per Cent. FRANZ FISCHER and GEORG PFLEIDERER (*Ges. Abhandl. Kennt. Kohle*, 1919, **4**, 440—447; from *Chem. Zentr.*, 1921, i, 349).—Antimony-cadmium alloys of approximately atomic composition show probably the highest thermo-electric power of all metals and alloys hitherto investigated. In one and the same fragment and in different fragments of the same alloy remarkably variable values for thermo-electric power were obtained, including some higher than any hitherto observed.

Such variations suggest that the thermo-electrical properties of

this alloy are much influenced by inhomogeneity. The thermal treatment is also of importance in this connexion. Thermo-electric power is altered at higher temperatures, not only by a reversible temperature effect, but also by an irreversible alteration of the material. Amalgamation depresses thermo-electric power. Alloys prepared by fusion under a mixture of lithium and sodium chlorides showed particularly low values, which, however, were increased by subsequent heating without the covering of fused salts. G. W. R.

The Behaviour of an Unattackable Electrode in the Reaction $3HNO_2 \rightleftharpoons 2NO + HNO_3 + H_2O$ at Equilibrium. ALFONS KLEMENC (*Zeitsch. Elektrochem.*, 1921, **27**, 110—112).—The normal potential of the reaction $2NO_2' \longrightarrow NO + NO_3'$ at 25° was calculated by Pick (A., 1920, ii, 409) on the assumption that this reaction takes place at an unattackable electrode. The author now shows, by comparing the measured potential when a platinum electrode is in equilibrium with the system, nitric acid–nitrous acid–nitric oxide, with the calculated potentials for the three reactions: (1) $NO + 2H_2O \longrightarrow 4H + NO_3'$; (2) $NO + H_2O \longrightarrow 2H^{\cdot} + NO_2'$; (3) $NO_2' + H_2O \longrightarrow 2H^{\cdot} + NO_3'$, that the observed value agrees with that calculated for the first of these reactions, which must therefore be regarded as the electrode reaction in solutions up to $3N$. In fairly dilute solutions (about $0{\cdot}3N$), the second reaction is superimposed on the first. The correspondence of Moore's measurements (A., 1913, ii, 467) with the thermodynamic calculations based on the assumption of $2NO_2' \longrightarrow NO + NO_3'$, was probably accidental and due to the uncertainty of the equilibrium measurements of Lewis and Edgar for the reaction $3HNO_3 \rightleftharpoons 2NO + HNO_3 + H_2O$, on which the calculation depended. E. H. R.

The Mechanism of the Exchange of Energy in the Electrochemical Passage of an Atom to the Ionic State. RENÉ AUDUBERT (*Compt. rend.*, 1921, **172**, 753—755).—The work necessary for the solution of an electrode in a solution of one of its salts may be considered as composed of two terms; a term w relative to the work necessary to draw an atom from the surface of the electrode, and a term w' relative to the work put into play in the passage of this atom to the ionic state. Considering the transformation of a gram-atom of the electrode we have $\epsilon Qn = Nw + Nw'$, where ϵ is the tension of solution of the electrode, n the valency of the ion, and N Avogadro's constant. Nw' may be expressed by Jq, where q is the heat of ionisation of a gram-atom of the element considered. The value of Nw can be calculated from the heat of vaporisation by the equation $JL = Nw + RT$ and thus it is possible to calculate ϵ. The calculated and observed values agree well in the cases examined except for cadmium and hydrogen. W. G.

The Electrical Phenomena Accompanying the Displacement of Metals. BARLOT (*Compt. rend.*, 1921, **172**, 857—859. Compare this vol., ii, 247).—If, under the experimental conditions previously

described (*loc. cit.*), the two fragments of zinc are connected to the two poles of an electric cell having a potential difference of one or two volts the figure formed by the lines of copper crystals radiating from the fragments obtained are disymmetrical and the neutral line takes a parabolic form. If the *E.M.F.* is sufficiently great there is no metallic deposit on the zinc connected to the negative pole. The formation of these figures is attributed to the action of the electric field produced by the more electro-negative metal. This action tends to orientate the positive ions of the electrolyte along the lines of force. At the same time these ions are subjected to the forces of crystallisation and when they pass to the metallic state the figures formed are the result of these two actions.

W. G.

Relationships at Copper Anodes in Solutions of Alkali Hydroxides. FR. JIRSA (*Zeitsch. Elektrochem.*, 1921, **27**, 30—34).—The potential of a copper anode in alkali solution has been measured. It is found that the addition of telluric acid to a copper anode in alkali does not cause a gradual depolarisation as is the case with a silver anode in similar circumstances (A., 1919, ii, 264). The potential of the electrode $Cu|Cu_2O_3||$, prepared without telluric acid, sinks rapidly to zero when the polarising current is cut off, but the same electrode, when in alkali solution containing telluric acid, has a constant potential difference. The cell $(Pt)Cu|Cu_2O_3,CuO,2K_2TeO_4 7N KOH,Cu(OH)_2||N KCl|Hg_2Cl_2|Hg$ has been measured at 18° and found to have the value + 0·22 volt. When solutions of alkali hydroxides are electrolysed between copper electrodes by an alternating current of 49 periods, the copper is oxidised, even when the possibility of atmospheric oxidation is rigorously excluded, and the copper passes into solution in the univalent condition.

J. F. S.

Transport Numbers of Liquid Amalgams. FRANZ SKAUPY (*Zeitsch. Physik*, 1920, **3**, 178—181).—A theoretical paper in which the explanation offered by Lewis, Adams, and Lamann (A., 1916, ii, 76) for the accumulation of the dissolved metal at the anode during the electrolysis of sodium and potassium amalgams is discussed. The author shows that the mercury ions wandering to the cathode force the residue of the solution, which contains the alkali metal, to the anode. The transport number, n, is connected with the concentration of the amalgam, c, the electron concentration of the mercury, and the degree of hydrargyration of the mercury ion, z, by the formula $n = u/v(1+z).c/100$, where u and v are the migration velocities of the complex mercury ions and the electrons respectively.

J. F. S.

Electro-endosmosis and Ion Adsorption. A. GYEMANT (*Kolloid Zeitsch.*, 1921, **28**, 103—114).—A method for the determination of electro-endosmosis is described which makes it possible to use any type of membrane. Making use of this new apparatus, the electro-endosmosis of a number of solutions has been investigated, using membranes of collodion, kaolin, carbon, agar, ferric

oxide, and filter paper. It is shown that the charge on which the electro-endosmosis depends can be attributed to ionic adsorption and in this connexion the nature of the adsorbent and the different adsorptions of the two ions are determinative. The adsorbent has the character of an acid, a base, or an ampholyte. The acid and basic membranes can be charged to the highest extent by hydrogen- or hydroxyl-ions respectively, but not discharged by these ions. In certain cases, it is possible to discharge these by tervalent ions. Ampholytes may be discharged by finite concentrations of hydrogen- and hydroxyl-ions. The so-called indifferent diaphragms behave either as acid or as ampholytic diaphragms, and correspondingly are only chargeable or dischargeable. Non-dischargeable but always negatively charged diaphragms are represented by collodion and agar, whilst the only known representative of a dischargeable membrane is charcoal. The analytically determined adsorption of an electrolyte furnishes no direct evidence on the charging produced by the electrolyte. In general, it is found that the smaller the analytically determinable adsorption the greater the charging of the diaphragm. J. F. S.

The Construction of Platinum Resistance Thermometers and Immersion Heating Coils of Low Lag. T. S. SLIGH, JUN. (*J. Amer. Chem. Soc.*, 1921, **43**, 470—475).—Improvements in constructional detail in the platinum resistance thermometers described in Bureau of Standards Bulletin, 1909, **6**, 150, and 1913, **9**, 483, are outlined. There is also described a convenient type of laboratory heating coil of low lag, specially suited for use as a bath thermo-regulator or for work involving the accurate measurement of heat supplied electrically. The heating coil is constructed by winding resistance ribbon on a flat strip of mica, insulating by means of thin mica side plates and enclosing in a flattened copper tube or sheath. [See *J. Soc. Chem. Ind.*, 1921, 326A.] E. H. R.

Calculation of the Specific Heats of Gases. W. HERZ (*Zeitsch. Elektrochem.*, 1921, **27**, 125).—Three equations are deduced for calculating $C_p - C_v$, the difference between the specific heats of a gas at constant pressure and constant volume. These are (1) $C_p - C_v = 0{\cdot}000087/d_kv_k$, where d_k and v_k are the critical density and volume respectively; (2) $C_p - C_v = 0{\cdot}0935L/T_s$, where L is the heat of vaporisation at the boiling point T_s; (3) since $L = p_kT_s/T_kd_k$ (A., 1919, ii, 494), it follows that

$$C_p - C_v = 0{\cdot}0935p_k/T_kd_k.$$

The formulæ are applied in a number of typical cases.

E. H. R.

Molecular Energy in Gases. (SIR) J. A. EWING (*Proc. Roy. Soc. Edin.*, 1920, **40**, 102—111).—The known facts with regard to the specific heat of gases from − 200° to 2000° have been reviewed and the following conclusions drawn. The increase in specific heat observed in most gases when heated is due to the setting up of to-and-fro vibrations of the atoms composing the molecules. The principle of equipartition does not apply to these

vibrations. In monatomic gases, substantially all the energy, so far as that is communicable, consists of energy of translation. Accordingly, the specific heat is sensibly constant, C_v having the value $\frac{3}{2}R$ and γ the value $\frac{5}{3}$. In diatomic gases, under normal conditions, the energy consists mainly of energy of translation and energy of rotation about axes transverse to the line joining the two atoms. The specific heat, C_v, is approximately $\frac{5}{2}R$, and $\frac{2}{5}$ of this quantity is accounted for by there being two (and only two) effective degrees of freedom of rotation. The normal value of γ is accordingly $1\frac{2}{5}$. When the gas is cold, the energy of vibration is nearly negligible, except in certain gases such as vapours of the halogens, where it forms an appreciable part of the whole energy even at ordinary temperatures. When a diatomic gas is heated, the to-and-fro vibration of the atoms comes increasingly into play and contributes a substantial addition to the energy, with the result that the specific heat rises and γ falls below $1\frac{2}{5}$. In all gases at all temperatures there is an equipartition of energy between each degree of freedom of translation and each effective degree of freedom of rotation. The abnormal behaviour of hydrogen at very low temperatures discovered by Eucken (A., 1912, ii, 232) may conjecturally be accounted for by supposing a change of molecular structure to occur which deprives the hydrogen molecule of its two normal degrees of freedom of rotation. If such a change of structure occurs it may be expected to exhibit hysteresis in relation to the temperature. In triatomic and polyatomic gases, there are three effective degrees of freedom of rotation which, along with the three degrees of freedom of translation, would make C_v equal to $3R$ and γ equal to $1\frac{1}{3}$ if there were no energy of vibration. But, in addition, there is in general a considerable amount of energy of vibration, resulting from to-and-fro movements of the atoms within the molecules, to which the principle of equipartition does not apply. Vibrations of relatively long period become important at relatively low temperatures. This makes the specific heat actually greater than $3R$ and γ less than $1\frac{1}{3}$, especially at high temperatures, when the energy of vibration becomes a large part of the whole energy. It does not appear to be necessary to have recourse to the quantum theory in dealing with molecular rotations in gases; at the same time, the observed facts do not conflict with the theory. The general effect of to-and-fro vibrations of atoms within the molecule of a gas is satisfactorily expressed in terms of the quantum theory. The resemblance which exists between the type of curve given by Planck's theory and the curve of magnetisation of a ferromagnetic substance suggests that if the nature of the atoms and their constraints were better understood the results might admit of interpretation in terms which would not be inconsistent with the older dynamics. J. F. S.

Specific Heat and Inner Atomic Vibrations. FRANZ SKAUPY (*Zeitsch. Physik*, 1921, 4, 100—104).—A critical discussion of the specific heat of compounds in connexion with the specific heat of the constituent elements. In order to bring the observed facts into line with the newer theory of atomic structure, the author

makes the assumption that the vibrations which chiefly condition the energy content of a solid substance are vibrations of the atomic parts, either the atomic nucleus and the whole electron sheath, or a part of the electron sheath and the residue of the atom. This vibration is characteristic of the atom, except in so far as it is influenced by the surrounding atoms. J. F. S.

Thermodynamics of Mixtures. V. MARIO BASTO WAGNER (*Zeitsch. physikal. Chem.*, 1921, **97**, 229—252. Compare this vol., ii, 162).—A mathematical paper in which the material previously published is further discussed and extended. The Dolezalek theory of binary mixtures and concentrated solutions is discussed and its position with regard to experimental data indicated (A., 1909, ii, 22). J. F. S.

Surface Tension and Heat of Vaporisation. W. HERZ *Zeitsch. Elektrochem.*, 1921, **27**, 25).—By combining the Trouton law with the Eötvös surface tension expression, the author has developed an expression connecting the surface tension with the heat of vaporisation. This has the form $L = 20\gamma/S^{\frac{2}{3}}M^{\frac{1}{3}}$, in which L is the heat of vaporisation, M the molecular weight, γ the surface tension at the boiling point, and s the density at the boiling point. The expression only holds approximately for normal liquids and not at all for associated liquids. From this formula the further expression $\rho = 1/10(M/s)^{\frac{1}{3}} . 0{\cdot}00102/42700$, in which ρ is the molecular diameter, is deduced. Using this formula, the diameter of the benzene molecule is found to be $1{\cdot}1 \times 10^{-8}$, which is of the same order as the value found by other methods. Combining the first equation with the expression $B = L/2v$, in which B is the internal pressure, this factor can be calculated by the formula $B = 10\gamma/(Mv)^{\frac{1}{3}} \times 42700/1033$, in which Mv is the molecular volume. The following values are calculated: benzene, 1830 atm.; ethyl acetate, 1425 atm.; and aniline, 2120 atm. J. F. S.

Heat of Vaporisation and Critical Data. W. HERZ (*Zeitsch. Elektrochem.*, 1921, **27**, 26).—The author has deduced a second formula whereby the heat of vaporisation of non-associated liquids may be calculated from a knowledge of the critical data (compare A., 1919, ii, 494). The expression has the form $L = 0{\cdot}00093T_s/d_kv_k$, where L is the latent heat of vaporisation, T_s the absolute boiling point, and d_k and v_k the critical density and volume respectively. Since the Trouton rule $ML/T_s =$ constant, it follows that $M . 0{\cdot}00093/d_kv_k$ must also be constant. The two formulæ are tested for a number of non-associated liquids and found approximately to represent the facts. J. F. S.

Calculation of the van der Waals's Constants *a* and *b*. W. HERZ (*Zeitsch. Elektrochem.*, 1921, **27**, 26—27).—Making use of expressions previously deduced (preceding abstract; A., 1919, ii, 494), the author has evolved three equations by means of which the constant b may be calculated. These have the form: (1) $b = T_s/2184L . d_k$, (ii) $b = v_k/2031$, and (iii) $b = 0{\cdot}0000216M/d_k$,

where the symbols have the significance given in the preceding abstract. The value of b is calculated for twelve substances by all three formulæ, and slightly divergent values are obtained. These are compared with the experimental figures, which are found to agree moderately well with some of the calculated values, although it cannot be said that any one of the formulæ is superior to the others. Two expressions for the calculation of a are also given, (i) $a = 6{\cdot}54 p_k v_k^2$ and (ii) $a = 1{\cdot}26 \times 10^8 p_k (M/d_k)^2$; again only a moderate agreement between the experimental and calculated values is obtained. Combining the last two formulæ, the relationship $v_k = 0{\cdot}0000439 M/d_k$ is obtained which connects the critical volume, critical density, and the molecular weight. J. F. S.

Vapour Pressure Regularities. IV and V. W. Herz (*Zeitsch. Elektrochem.*, 1921, **27**, 125—126. Compare A., 1920, ii, 163).—IV. If in van der Waals's equation the critical temperature is replaced by the expression $\frac{1}{2}(1/K_{20} + 293)$, where K_{20} is the co-efficient of expansion at 20°, the value of the factor a is close to, generally greater than, 3 for a number of liquids quoted, chiefly organic esters. In addition, the factor p_k (critical pressure) in van der Waals's equation can be replaced by the quantity $1/K_{20} + 293/0{\cdot}88n$, where n is the sum of the valencies of the constituent atoms. The value of a is thus calculated for a number of non-associated organic liquids.

V. The constant of Cederberg's vapour pressure formula (Thermodynamische Berechnung chemischer Affinitäten, p. 55, Upsala, 1916) when this is applied to organic compounds has an abnormally high value, increasing with the molecular weight of the compound. E. H. R.

Separation of Miscible Liquids by Distillation. A. F. Dufton (*Phil. Mag.*, 1921, [vi], **41**, 633—646).—The separation of unit mass of a constituent A of a binary mixture of A and B involves the evaporation of a mass $1 + 1/a(k - 1)$ of the liquid, where a is the relative proportion of A in the liquid and $k = V_a L_b / V_b L_a$, where V_a, V_b are the masses of A and B in the vapour, and L_a, L_b the masses in the liquid. If Q is the latent heat of evaporation of the liquid, the quantity of heat required to separate unit mass of A is $Q\,[1 + 1/a(k - 1)]$. The ratio of the mass of A separated by this amount of heat to unit mass is called the thermal efficiency of the still-head. Mixtures of benzene and toluene were investigated with the Dufton still-head (A., 1919, ii, 136). With slower rates of heating the greatest thermal efficiency was obtained when the distillation was at the maximum rate to yield pure benzene. The thermal efficiency is reduced if loss of heat in the column is unduly prevented. J. R. P.

Heat of Sublimation of Carbon. H. Kohn (*Zeitsch. Physik*, 1920, **3**, 143—156).—It is shown that the temperature curve of the positive crater of a carbon arc, burning under pressures above atmospheric, can be regarded as the vapour pressure curve of carbon when pure carbon poles are used for the arc. This has been pre-

viously shown to be true also for reduced pressures (Fajans, *ibid.*, 1920, 1, 100—118). The calculation of the heat of sublimation made by Fajans is incorrect, owing to the use of inaccurate temperature values given by Lummer (Verflüssigung der Kohle Braunschweig, 1914). These temperatures have been corrected in the present work, and it is shown that the heat of sublimation of carbon, calculated from measurements over a pressure range 0·3—8·0 atm. which corresponds with a temperature range 4200—4700° abs., is 163·5 Cal. The heat of sublimation of the diamond therefore becomes 168 Cal., a value which approximates very nearly to the figure 142 Cal. which is obtained from the integrated vapour pressure formula by introducing the chemical constant for monatomic gases.

J. F. S.

The Thermochemical Data of Cadmium Chloride and Iodide. Hugh Stott Taylor and George St. John Perrott (*J. Amer. Chem. Soc.*, 1921, **43**, 484—493).—The *E.M.F.* and their temperature coefficients have been determined for the following cells.

Cadmium amalgam | $CdCl_2,2{\cdot}5H_2O$ and saturated solution | AgCl | Ag, 0·62478 volt at 25°; 0·6249 volt at 0°.

Cadmium amalgam | $CdCl_2,2{\cdot}5H_2O$ and saturated solution | $PbCl_2$ | lead amalgam, 0·1484 volt at 25° and 0°.

Cadmium amalgam | CdI_2 and saturated solution | AgI | Ag, 0·305 volt at 40°, 0·3035 volt at 25°, 0·3006 volt at 0°.

Cadmium amalgam | CdI_2 and saturated solution | PbI_2 | lead amalgam, 0·1135 at 40°, 0·10725 at 25°, 0·09655 volt at 0°.

Values for the heat of formation of cadmium chloride and of cadmium iodide from their elementary constituents were calculated from the electrical measurements. In the case of cadmium chloride it is deduced that a value of 93,000 cal., obtained from the electrical measurements, is more trustworthy than Thomsen's value from thermochemical measurements. Calculations of the heat of formation of cadmium iodide from different electrical data gave somewhat discordant results. This constant was therefore redetermined by direct measurement of the heat of formation, by dropping iodine into a solution of potassium iodide containing finely divided cadmium in suspension. The value found was 48,440 cal. and, combining the values determined directly and electrically, it is concluded that the most probable value is about 48,500 cal.

E. H. R.

The Elementary Quantity of Energy Brought into Action in Solution. René Audubert (*Compt. rend.*, 1921, **172**, 676—678).—On the basis that solution and vaporisation obey the same laws, the value of ρ/T, where ρ is the molecular latent heat of solution and T the temperature which corresponds, for a state of saturation, to an osmotic pressure of one atmosphere, should be a constant. It is not possible to verify this directly, but by extrapolation from known results in the case of a number of salts the value of ρ/T is found to be 30—32, for $\pi = 1$ atm. From this the elementary quantity of energy necessary to cause a molecule

to pass into solution is calculated to be $18 \times 10^{-16} T$ ergs, which is the value found for the energy of dissociation of solids and for the energy of sublimation. W. G.

Surface Tension of Mercury in a Vacuum. JULIO PALACIOS (*Anal. Fís. Quím.*, 1920, **18**, 294—307).—Using a specially devised apparatus and mercury the freedom of which from impurities was verified spectroscopically, the author obtains the value 402 dynes/centimetre for the surface tension of mercury. This result is considerably lower than the values obtained by earlier workers. G. W. R.

Interfacial Tension. I. The Statical Measurement of Interfacial Tension in Absolute Units. WILLIAM COLEBROOK REYNOLDS (T., 1921, **119**, 460—465).

Interfacial Tension. II. The Relation between Interfacial and Surface Tension in Sundry Organic Solvents in Contact with Aqueous Solutions. WILLIAM COLEBROOK REYNOLDS (T., 1921, **119**, 466—476).

The Adsorption of Alkali Chlorides by Animal Charcoal. HANS HARTLEBEN (*Biochem. Zeitsch.*, 1921, **115**, 46—51).—All alkali chlorides are adsorbed by animal charcoal within the limits of experimental error to the same extent. S. S. Z.

Adsorption of Formaldehyde by Animal Charcoal. W. MOELLER (*Kolloid Zeitsch.*, 1921, **28**, 127—132).—The adsorption of formaldehyde by animal charcoal has been examined in both acid and neutral solution. The adsorption in both cases is very great and follows the adsorption laws; that is, the adsorption is dependent on the concentration. The adsorption of formaldehyde by animal charcoal in acid solution is dependent on the volume in the sense that a great deal more is adsorbed from a large volume than from a small volume of equal concentration. In neutral solution the adsorption is independent of the volume and is practically dependent on the total quantity of formaldehyde present. In neutral solution the adsorption is independent of the time, and equilibrium is set up in a very short time. The adsorption from acid solutions is dependent on the time and equilibrium is set up very slowly, so that even after eight days' contact no equilibrium has been reached. J. F. S.

The Determination of the Sorption of both Solvent and Solute. I. Preliminary. The System: Benzene–Iodine–Charcoal. ABU MOHAMED BAKR and JOSEPH EDGAR KING (T., 1921, **119**, 454—460).

Explanation of an Apparent Anomaly outstanding in the Results of Measurement of Dissociation Pressures. ALAN W. C. MENZIES (*Proc. Roy. Soc. Edin.*, 1920, **40**, 158—160. See A., 1920, ii, 412).

The Dissociation Pressures of Iron Nitrides. ARTHUR A. NOYES and LEIGHTON B. SMITH (*J. Amer. Chem. Soc.*, 1921, **43**, 475—481).—Iron nitride is readily formed at 460° by the action

of ammonia gas on iron. If the equilibrium constant of this reaction in its general form $2Fe_xN + 3H_2 = 2xFe + 2NH_3$ be expressed by K_1, and that of the reaction $N_2 + 3H_2 = 2NH_3$ by K_2, it is shown that the dissociation pressure of iron nitride can be expressed by K_1/K_2. The value of K_2 at 460°, calculated from known data, is $5{\cdot}10 \times 10^{-5}$; that of K_1 has been determined by the authors. The method consisted in admitting ammonia or hydrogen to the reaction tube containing iron and iron nitride and, after a period of fifteen to thirty minutes, suddenly withdrawing and cooling a quantity of the gas and analysing it. The experiments were made at 460°, and the time was chosen to allow the first above reaction to come to equilibrium before slower reactions could cause complications. The ratio Fe : N in the solid phase was varied between 17·1 and 2·59. When this ratio was greater than 9, the equilibrium constant $K_1 = (P_{NH_3})^2/(P_{H_2})^3$ remained at 0·8 to 1·2, indicating probably the existence of a stable nitride, Fe_8N. When the Fe : N ratio became 7·7, the constant became 5·2 and increased to 30 with Fe : N = 4·9 : 1. Finally with Fe : N = 2·6 : 1 the value of K_1 fell again to 2·1. These stages may correspond with the formation of a metastable nitride such as Fe_4N in solid solution with the first, Fe_8N, or of two metastable nitrides such as Fe_6N and Fe_4N as separate solid phases; and finally of a stable nitride, probably Fe_2N.

The dissociation pressures of the nitrides in the above solid phases were calculated from K_1/K_2 and were found to be 20,000, 102,000, 590,000, and 41,000 atmospheres respectively. The work affords an example of the possibility of determining, through the study of a metastable equilibrium, the equilibrium conditions of a reaction not directly accessible to measurement. If, in the above reaction, complete equilibrium were established, all but about 0·1% of the ammonia would be dissociated and the iron nitride, with its high dissociation pressure, would not form at all.

E. H. R.

Solubility. I. FRITZ EPHRAIM (*Ber.*, 1921, **54**, [*B*], 379—385).—Solubility is defined as a type of miscibility, and it is pointed out that the latter phenomenon is invariably encountered with substances which are closely allied chemically. The solubility of salts in water depends on the ability of their molecules or ions to surround themselves with a water mantle and thus to approximate in character to the solvent. Since the author's researches (A., 1918, i, 389; 1920, ii, 378) have shown that the additive capacity of compounds is greatly dependent on spatial relationships, it would be expected that, if this factor is connected with the solubility, the latter would also be greatly dependent on the structure of the molecule. If a molecule is composed of a small kation surrounded by several very large anions, a hollow exists around the former which can be filled by neutral portions; if these are water, the whole molecule becomes water-like and therefore soluble. Sparing solubility is encountered with salts with spatially similar anions and kations.

The ideas which are thus developed are applied to the examination

of several cases in which addition of water is unlikely by reason of the presence of other neutral portions, as with the cobaltammines, or of the absence of any tendency to unite with water as in the case of the benzene or naphthalene ring. Comparable spatial relationships are encountered with the salts of the alkaloids and those of positive complex cobaltammines, and it is found (for details see this vol., ii, 338) that all the known precipitants for alkaloids also yield precipitates with the *leuco*-cobalti-compounds, $[Co(NH_3)_6]X_3$, and that the compounds thus formed are so similar that they would be scarcely distinguishable by eye from one another if the cobalt derivatives did not impart certain colorations. Conversely, many cobaltammines give precipitates with the complex anion, $\left[Co\begin{matrix}(NH_3)_2\\(NO_2)_4\end{matrix}\right]$, and precisely similar precipitates are now found to be given by alkaloids with this reagent. These reactions do not depend on the highly complex character of the cobaltammines, since they are also exhibited by the relatively less complex ammines of bivalent metals. Salts composed of small kations and a very large anion are generally freely soluble, but can be rendered insoluble when the two parts are spatially matched by the addition of neutral portions to the kation. Thus the picrates of small kations are freely soluble, but those of the ammines of small kations are sparingly soluble (following abstracts).

A second possible factor governing the solubility of salts is their tendency towards isomerisation. Thus Hantzsch (A., 1918, i, 4) has shown that the esters and salts of an acid frequently exhibit very divergent optical behaviour, whilst that of the acid itself lies between the two extremes. This is accounted for by the supposition that the alkyl group of the ester is attached exclusively to one oxygen atom, R·CO·OAlk, whilst the metallic atom of the salt may be related to two oxygen atoms, $R\cdot C{<}\begin{matrix}O\\O\end{matrix}\Big\}X$, the acid being a mixture of the forms $R\cdot CO\cdot OH \rightleftharpoons R\cdot C{<}\begin{matrix}O\\O\end{matrix}\Big\}H$. These investigations are based on observations on dissolved substances, but it appears justifiable to conclude that the undissolved salt can also contain the ester form, R·CO·OX, and that this is particularly the case with many sparingly soluble salts; the hydratisation of the metal would certainly be more difficult in the "ester" than in the "salt" form, since it is to a certain extent in complex combination. Observations on benzoates (compare A., 1918, i, 389) indicate the possibility of the existence of both types, since a solution of sodium benzoate only slowly yields a precipitate with salts of certain heavy metals such as nickel, cobalt, manganese, or bivalent iron, which is almost colourless, whereas the other salts of these metals are in general coloured and the mother liquors retain the colour of the metallic salt solution. The co-ordination form $\left[R\cdot C\begin{matrix}:O_2\\ .X\end{matrix}\right]$ appears to be even more probable for the insoluble salts than the ester form.

Sparingly soluble salts of the ionisable type are also found in

which anion and kation are so spatially adapted to one another that the addition of water molecules is exceedingly difficult, (K_2PtCl_6,$KClO_4$). A fundamental difference, however, exists between the sparing solubility of salts of the ester type and ionisable type in that in the former case there is practically no chance of solubility in this form, whilst in the latter less or greater solubility is always present. H. W.

Solubility. VI. Thermodynamic Relation between Solubility and Internal Pressure. JOEL H. HILDEBRAND (*J. Amer. Chem. Soc.*, 1921, **43**, 500—507).—In the case of a binary liquid mixture it is shown by a process of thermodynamic reasoning that, if Raoult's law holds, the two liquids mix without any heat effect and without volume change. It follows from this that only such liquids as have identical values of $(\partial P/\partial T)_V$, that is, the same rate of change of pressure with temperature at constant volume, are capable of yielding solutions obeying Raoult's law under all conditions, that is, at all temperatures, pressures, and compositions. The above term is seen to be related to the equation of state $P + (\partial E/\partial V)_T = T(\partial P/\partial T)_V$, where E denotes total energy. It is proposed to define "internal pressure" as $T(\partial P/\partial T)_V$, which is practically equal to $(\partial E/\partial V)_T$, since P is small in comparison with the other terms. Defined in this way, internal pressure is capable of accurate measurement, since $(\partial P/\partial T)_V = -(\partial P/\partial V)_T(\partial V/\partial T)_P = \alpha/\beta$, where α, the coefficient of expansion, is $(\partial V/\partial T)_P/V$ and β, the compressibility, is $-(\partial V/\partial P)_T/V$. The values for the internal pressure of a number of liquids are calculated in this way.

Since the internal pressure of a solution of non-polar liquids is probably a linear function of the composition expressed in mol-fractions, it is probable that the difference between the internal pressures of the two pure liquids would determine, at least to a considerable extent, the deviation of the solution from Raoult's law. The relation between surface tension and internal pressure is discussed. It is shown that the criteria previously used for estimating relative values of internal pressure are in substantial accord with the thermodynamic definition of internal pressure now proposed, although it is theoretically preferable to use surface energy in place of surface tension (compare A., 1918, ii, 36). E. H. R.

The Miscibility of Liquids. CHARLES E. FAWSITT and CHRISTIAN H. FISCHER (*J. Roy. Soc. New South Wales*, 1919, **53**, 162—165).—A table of organic liquid substances was drawn up by Holmes (T., 1913, **103**, 2147) in which the liquids were arranged in the order of the radii of their molecular volumes (assuming the molecules to be spherical) starting with water, and it was shown that this table constituted, in fact, a miscibility table. The authors have drawn up an extended table, from experiments with the different substances, comprising 55 liquids, arranged in such an order that, if any two of them are miscible, then all the liquids between these two are perfectly miscible. The order of the liquids differs slightly from that in Holmes's table. Replace-

ment of hydrogen in a hydrocarbon by $\cdot OH$, $\cdot CO_2H$, $\cdot C_2H_3O_2$, or $\cdot NH_2$ brings the liquid nearer the beginning of the table, whilst replacement of hydrogen by $\cdot CH_3$ moves it in the opposite direction. Unsaturated hydrocarbons are nearer the beginning of the table than the corresponding saturated hydrocarbons. E. H. R.

Volume Changes in the Process of Solution. GEORGE JOSEPH BURROWS (*J. Roy. Soc. New South Wales*, 1919, **53**, 74—99). —The specific or molecular solution volume of any solute is generally calculated on the assumption that the volume of the solvent is unaltered by the process of solution, any change in volume of the system being attributed to the solute. The solution volumes of the following substances in water at different concentrations were determined on this assumption from measurements of the densities of the different solutions at 25° or 30°: potassium chloride, mercuric chloride, saccharamide, succinic acid, succinamide, tricarballylamide, carbamide, acetamide, propionamide, and sucrose. In most cases the solution volume was found to increase with concentration, the change being most marked with electrolytes, but in the cases of mercuric chloride and acetamide the solution volume decreased with increasing concentration. It is pointed out, however, that these changes in specific solution volume of the solute are only apparent and must be in some measure due to changes in the volume of the solvent. In some cases, for instance in dilute solutions of magnesium sulphate, the volume of the solution is actually less than the volume of water present. Measurements were made of the density of solutions of formamide in water over the complete range from 0% to 100% of formamide, regarding the formamide as the solute. The solution volume of the formamide steadily increased with increasing concentration, whereas the relative contraction of the system actually increased from 0% to 44% formamide and then decreased. Similar results were obtained with solutions of ethyl alcohol in water. The volume changes cannot therefore be attributed to the solute alone.

The molecular solution volumes determined for the above organic substances, which do not vary to any great extent with concentration, agree closely with the values calculated from Traube's atomic solution volumes and co-volume (A., 1895, ii, 70; 1896, ii, 152, 354).

The molecular solution volumes of the amides of the fatty acids from formic to hexoic were determined in ethyl alcohol at 30° and were found to be independent of concentration. The difference between the volumes of consecutive members of the homologous series was constant at 16·8 up to butyramide, but for higher members the difference increased.

A study was also made of solution volumes in mixtures of solvents of varying composition. The value of the solution volume of benzophenone in mixtures of acetone and benzene was intermediate between the values in the pure solvents, but in acetone–ethyl alcohol mixtures the value was identical with that in the alcohol alone. Carbamide, formamide, acetamide, propionamide, and sucrose were

examined in water–alcohol mixtures and in every case the specific solution volume in the mixture was greater than in either solvent alone. In the case of formamide the solution volume in the mixed solvent was actually greater than the specific volume of the pure liquid solute. In each case a maximum value for the solution volume of the solute was found at a certain composition of the mixed solvent, but the position of this maximum varied with different solutes. The author rejects the solvate theory, and considers that the volume changes which occur on mixing liquids or on dissolving substances in simple solvents or mixtures of solvents result from a rearrangement of the molecules in the system to admit of closer packing. E. H. R.

The Power of Solution and Ionisation of Non-aqueous Solvents toward Binary Salts. P. WALDEN (*Zeitsch. Elektro chem.*, 1921, **27**, 34—37).—A theoretical paper in which from previously published data the relationships between the solvent power and ionising power toward binary electrolytes are considered for a number of non-aqueous solvents. It is shown for the binary salt tetramethylammonium thiocyanate, which is a strong electrolyte, that at the saturation point the degree of ionisation is practically the same in all the solvents examined, $\alpha_1 = \alpha_2 \ldots\ldots = 0{\cdot}380$. The actual values given, where V is the number of litres of solvent containing one gram-molecule of tetramethylammonium thiocyanate and α is the degree of ionisation at 25° are: methyl alcohol, $V = 2{\cdot}18$, $\alpha = 0{\cdot}377$, nitromethane, $V = 3{\cdot}59$, $\alpha = 0{\cdot}385$; acetonitrile, $V = 4{\cdot}54$, $\alpha = 0{\cdot}379$; ethyl cyanoacetate, $V = 10{\cdot}95$, $\alpha = 0{\cdot}381$; propionitrile, $V = 20$, $\alpha = 0{\cdot}390$; acetone, $V = 37{\cdot}6$, $\alpha = 0{\cdot}369$; epichlorohydrin, $V = 27{\cdot}8$, $\alpha = 0{\cdot}388$; phenylacetonitrile, $V = 43{\cdot}7$, $\alpha = 0{\cdot}374$, and methyl ethyl ketone, $V = 98{\cdot}9$, $\alpha = 0{\cdot}381$. The solubility of the same salt is given by the expression $\epsilon/\mu^{\frac{1}{3}} \sim 34$ for different non-aqueous solvents when ϵ represents the dielectric constant and μ the molecular solubility. J. F. S.

Reactivity and Conductance of Benzene Solutions. H. P. CADY and E. J. BALDWIN (*J. Amer. Chem. Soc.*, 1921, **43**, 646—651).—According to Allen (*Kansas Univ. Sci. Bulletin*, 1905), and Cady, and Lichtenwalter (A., 1913, ii, 916), benzene solutions of salts of organic acids, which gave precipitates on treatment with dry hydrogen chloride, showed a conductivity in accordance with the dissociation hypothesis. The objection of Koenig (A., 1914, i, 653) that the salts in question were slightly basic has now been met by a study of copper oleate, barium erucate, copper stearate, and silver melissate, obtained from sodium salts in the preparation of which a slight excess of acid was employed. Solutions of these salts in benzene showed an appreciable conductivity, which was increased on passing in dry hydrogen chloride, but gradually diminished in the first two cases owing to formation of a precipitate. A similar result followed on the addition of a solution of stannic chloride in benzene to that of copper oleate (compare Koenig, *loc. cit.*). A solution of oleic acid in benzene was practically

non-conducting, and was only slightly affected in this respect by hydrogen chloride, but the addition of a stannic chloride solution gave rise to a considerable conductivity. J. K.

Electro-crystalline Properties as Conditioned by Atomic Lattices. (SIR) JOSEPH LARMOR (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 1—10).—The assumption that the crystal lattice consists of atoms (ions), not molecules, is considered with relation to the charges on the ions. It is shown that compensating surface charges on certain faces of crystals are required. Dielectric excitation is regarded as due to the relative displacement of the positive and negative component lattices under the influence of the electric field. If the lattice has spiral features this relative displacement may involve twisting, and optical rotation may be produced. The twisting is, in the case of quartz and optically active liquids, roughly comparable with the elongation. Double refraction induced by strain is attributed to bending of the ionic lattices or fragments of such lattices. J. R. P.

Ionic Size and Lattice Energy of the Alkali Haloids for Atom Models with Cubic Symmetry. HUGO SCHWENDENWEIN (*Zeitsch. Physik*, 1921, **4**, 73—88).—The lattice potential of the alkali haloids have been recalculated by means of the Rella formula (*ibid.*, 1920, **2**, 157) on the basis of the Landé cubic ring model (*ibid.*, 1920, **2**, 83). By means of the equilibrium conditions the ionic radii are then calculated whereby values are obtained which differ considerably from those given by Landé. If these values are used to calculate the lattice energy a series of quantities is obtained for the alkali haloids which are in very good agreement with those found from the heat of solution. The electron affinity values calculated for the various alkali haloids agree better amongst themselves than those obtained according to the original Born formula, but the compressibility of the crystals is too great. In general, the present calculations confirm the earlier calculations of Fajans and Herzfeld (*ibid.*, 1920, **2**, 309) made on the basis of the cube corner model. J. F. S.

Photometric Methods and Apparatus for the Study of Colloids. S. E. SHEPPARD and FELIX A. ELLIOTT (*J. Amer. Chem. Soc.*, 1921, **43**, 531—539).—Two types of photometer, distinguished as vertical and horizontal types, for the study of colloids, are described. The vertical type can be modified for use as a nephelometer, colorimeter, microphotometer, dispersimeter, or turbidimeter. The horizontal type is strictly a transmission and scatter photometer, and is useful for determining particle size, comparative turbidities, and coagulation velocities. For a full description of the apparatus, its mode of use, and a discussion of its limitations the original must be consulted. E. H. R.

The Zone of Maximum Colloidality. Its Relation to Viscosity in Hydrophile Colloids, especially Karaya Gum and Gelatin. JEROME ALEXANDER (*J. Amer. Chem. Soc.*, 1921, **43**, 434—440).—The viscosity of reversible emulsoid or hydrophile colloids sometimes

increases as the dispersed phase becomes finer, as in oil emulsions, for example, or sometimes as the dispersed phase becomes coarser, as in the case of soaps or butyric acid. There appears to be, in fact, a "zone of maximum colloidality," above which viscosity decreases with coarser subdivision, as the Brownian movement becomes sluggish, and below which it also decreases as molecular dimensions are approached. This zone will probably differ with different substances. The approach towards the zone of maximum colloidality from the side of coarse dispersion is illustrated by the clays, and from the side of molecular dispersion by the salts of the fatty acids. Experiments in which Karaya gum ground to different degrees of fineness was dispersed in water showed that the viscosity increased with increasing fineness of subdivision of the particles. Increase in viscosity accompanies the hydration and swelling of the particles, and as the dispersed phase becomes less viscous by swelling, the colloid as a whole becomes more viscous. The mechanism of the hydration process is discussed at some length and illustrated by the behaviour of the dried gum. The dehydration which occurs on drying appears to be accompanied by the removal of the protective aqueous films surrounding the micelles or their primary particles, in consequence of which the molecules or molecular groups approach one another so closely that the attraction of water or its ions is unable to separate them. The insolubility of heated gelatin is brought about in a similar manner. The decrease in the viscosity and jelly strength of highly degraded glue or gelatin probably does not represent a decrease in the dispersion, as has been suggested, but an increased dispersion, involving or followed by the formation of a small quantity of an insoluble or adsorption compound. E. H. R.

The Elastic Properties of Gelatin Jellies. S. E. SHEPPARD and S. S. SWEET (*J. Amer. Chem. Soc.*, 1921, **43**, 539—547).—Measurements of the modulus of rigidity of gelatin jellies, at different concentrations under torsion show that they follow Hooke's law nearly up to the breaking point, the elastic limit very nearly coinciding with the so-called tenacity (*J. Ind. Eng. Chem.*, 1920, **12**, 1007). The relation between the modulus of elasticity E and the concentration is expressed by $E = kc^n$ over a limited range, but the constants k and n differ for different grades of gelatin. Measurements of the effect of acidity on the elasticity showed that the latter is not a simple function of the hydrogen-ion concentration. The effect of the addition of alcohol is to increase the modulus of rigidity up to about 25% alcohol, after which the strength decreases. With above 40% alcohol, alcohol and water are squeezed out of the jelly under torsion, and the residual jelly becomes transparent and gives almost unlimited twist. Glycerol increases the jelly strength. The results indicate that gelatin jellies may represent any transition stage between two extreme types, one a two-phase type of structure with sub-microscopic period, the other a type in which mechanical strength must be attributed to solution forces, the system being physically homogeneous down to molecular or submolecular dimensions. E. H. R.

Protective Colloids. IX. Isinglass as Protective Colloid. I. Colloid Chemical Investigation of Isinglass. A. GUTBIER and P. BECKMANN (*Kolloid Zeitsch.*, 1921, **28**, 167—172).—Colloidal solutions have been prepared from isinglass, by digesting with water, chloroform water, and water to which a quantity of glycerol has been added. The sols thus produced have been subjected to ageing experiments in various concentrations. The viscosity of the solutions has been measured in various concentrations and at various periods after preparation. The influence of hydrochloric acid, potassium chloride, and sodium hydroxide has also been followed by the change in the viscosity brought about by these substances. The results show that the addition of these electrolytes does not bring about any fundamental change in the nature of the colloid. The viscosity data are all expressed in curves in the paper. J. F. S.

The Velocity of Flocculation of Selenium Sol. II. Flocculation by Means of Barium Chloride. H. R. KRUYT and A. E. VAN ARKEL (*Rec. trav. chim.*, 1921, **40**, 169—191. Compare A., 1920, ii, 739).—In the flocculation of selenium sol by barium chloride, it is again shown that von Smoluchowski's theory is not capable of entirely explaining slow flocculation. There is a wide range where it is verified, particularly for diluted sols, but there is a range where departures from the theory are observed, but in a contrary sense to those observed with potassium chloride (*loc. cit.*).

A series of measurements of cataphoresis was made with the selenium sol to determine the influence of electrolytes on the potential of the surface of contact. The results are examined and discussed in the light of Smoluchowski's theory and the observations of other workers, but no definite conclusion is drawn.

A comparison between gold and selenium sols is given, and the relationship between the potential of the limit surface, the concentration of the electrolyte, and the probability of adhesion are discussed. The departure from Smoluchowski's theory with respect to the duration of flocculation is observed to some slight extent with gold sols. W. G.

Coagulation and Solution of Silver Bromide Sols by Ammonia. RUDOLF AUERBACH (*Kolloid Zeitsch.*, 1921, **28**, 124—126).—The action of ammonia on silver bromide hydrosols has been examined by means of turbidity measurements, when it was found that coagulation and hydrolysis occur mutually in the same system. It is shown that in medium, but greater than equivalent, concentrations of ammonia the coagulation velocity at first predominates, but at higher concentrations the velocity of solution predominates. J. F. S.

Ultramicroscopic Structure of Soaps. W. F. DARKE, J. W. MCBAIN, and C. S. SALMON (*Proc. Roy. Soc.*, 1921, [*A*], **98**, 395—409).—The ultramicroscopic structure of soaps and the rapid changes which occur have been recorded and examined by the use of a cinematograph camera. The ultramicroscopic observations

of Zsigmondy and Bachmann (A., 1913, ii, 194) have been confirmed, interpreted, and extended. Their observations referred almost entirely to soap curds and not to gels or sols, for the latter usually exhibit in the ultramicroscope nothing but Brownian particles, and those only under definite conditions. Curds of sodium soaps consist of a felt of hydrated fibres enmeshing and in equilibrium with a soap sol or gel of definite concentration, the solubility rising rapidly with temperature. The individual fibres may be many centimetres long, but they are barely of microscopic diameter. Potassium soap solutions, on cooling, first develop fibres which are similar to those of the sodium soaps, except that they are only a few hundredths of a millimetre in length, and they have a strong tendency to form twins. The stable condition at the ordinary temperature is, however, the formation of innumerable tiny lamellar crystals of hydrated soap. The hydrogen soap, cetylsulphonic acid, is similar to the potassium soaps, but the particles of colloidal cetylsulphonic acid are very much more prominent. J. F. S.

Application of Statistics to Chemical Equilibria. K. F. Herzfeld (*Physikal. Zeitsch.*, 1921, **22**, 186—191).—A report on the modern work in connexion with the statistical method of treating chemical equilibria. The work is discussed in connexion with the classical theory, the quantum hypothesis, and charged systems. J. F. S.

The Properties of Diagrams. Curves Representative of the Displacement of the Equilibrium of Chemical Systems. Jean Barbaudy (*Compt. rend.*, 1921, **172**, 591—593).—A series of mathematical equations is deduced and their application to a consideration of the equilibrium in certain chemical systems discussed. W. G.

The Equilibrium between Nitric Oxide, Nitrogen Peroxide, and Aqueous Solution of Nitric Acid. Charles L. Burdick and E. Stanley Freed (*J. Amer. Chem. Soc.*, 1921, **43**, 518—530).—In the absorption by water of nitrous gases, such as are formed by the oxidation of ammonia, the reactions taking place are: (1) $2NO + O_2 = 2NO_2$; (2) $3NO_2 + H_2O = 2HNO_3 + NO$. The first of these reactions progresses slowly, whilst the second, although proceeding with great rapidity, comes to a stop at an equilibrium depending on the strength of the aqueous solution of nitric acid in which absorption is taking place and on the temperature. The equilibrium conditions of this second reaction have been studied by the determination of the partial constant $K_1 = (P_{NO})/(P_{NO_2})^3$ for nitric acid at different concentrations and temperatures. The experimental method used was to bubble nitrogen peroxide diluted with a large quantity of nitrogen through nitric acid at the required temperature and concentration and to determine the partial pressures of nitric oxide and nitrogen peroxide in the issuing gas. From measurements of the vapour pressures of water and nitric acid in nitric acid of different concentrations, the partial constant $(P_{HNO_3})^3/(P_{H_2O})$ was

also calculated. The experiments were limited to solutions containing between 10% and 55% of nitric acid, because with lower strengths the partial pressure of the nitrogen peroxide, and with higher strengths that of nitric oxide, was too small to measure. In order to obtain values of K_1 for more dilute solutions it was assumed that, for low concentrations, where K_1 approaches infinity, the reaction is complete. By means of vapour pressure data it was possible to extrapolate for concentrations of nitric acid above 55%. From the results obtained a table is given showing the percentage conversion of nitrogen peroxide into nitric acid by aqueous solutions containing from 5—65% of nitric acid at temperatures from 10—75°, for concentrations of nitrogen peroxide in the original gas varying from 0·1—20%. The favourable conditions for complete absorption are low temperature, dilute nitric acid, and high concentration of peroxide in the gas. With nitric acid stronger than 50%, absorption is very poor under all conditions.

From the above equilibrium and vapour pressure data, the free energies of nitric acid vapour and nitric acid in aqueous solutions were calculated. E. H. R.

Precipitation Equilibria. ROBERT GRIESSBACH (*Zeitsch. physikal. Chem.*, 1921, **97**, 22—94).—The equilibria set up in reactions of the type indicated by the equation aA_mS_n(solution) + bB_oR_p(solution) $\rightleftharpoons cA_qR_r$(solid) + dB_sS_t (solution) have been investigated theoretically by treating the system as a trivariant three-phase equilibrium. The relationship between a given dependent and, at constant temperature, two independent concentrations can be expressed by a system of spacial co-ordinates:

$$\phi_1(N, C_1, C_2[C_3], \alpha, \beta, \gamma, x\,L) = 0,$$

where N is the quantity of solid phase per litre of solution (A_qR_r); positive when precipitated, negative when dissolved; C_1 the concentration of the salt to be precipitated (A_mS_n), C_2 the concentration of the precipitating salt (B_oR_p), C_3 the concentration of the salt B_sS_t should such be present before precipitation. α, β, γ, x are the reciprocals of the mass action constants for the four salts respectively, and L is the solubility product of the precipitate (A_qR_r). A second form of representation is more convenient, namely $\phi_{II}(\odot, C'_3\Delta) = 0$, in which $\odot = (C_1 - N)$ the solubility error of the determination, $C'_3 = (C_1 + C_3)$ the total quantity of neutral salt B_sS_t, from which, together with the excess of the solid phase and the excess of precipitant Δ the solution equilibrium can also be reached, $\Delta = C_2 - C_1$. Certain special assumptions concerning the variables lead to three elementary functions which correspond with definite plane intersections through the plane $\phi = 0$ and define the theoretical and experimental conditions of the equilibrium. $\phi = 0$ determines the influence on the sparingly soluble phase of the salts with a common ion (A_mS_n) and (B_oR_p). $\chi = 0$ indicates the influence of the salt with dissimilar ions (B_sS_t) on the solubility of the sparingly soluble phase, and $\psi = 0$ is the saturation curve of A_qR_r for the mutually precipitating salts (A_mS_n) and (B_oR_p). The introduction of one of the quantities C'_3, Δ, C_3

as parameter together with the above generalisations leads to the following $\phi_{c'_3>0} = 0$; $\chi_{\Delta>0} = 0$; $\psi_{c'_3>0} = 0$. After making the usual simplifications the equilibrium scheme is calculated for the case AS(solution) + BR(solution) $\rightleftharpoons$ AR(solid) + BS(solution). The results obtained are then applied to experimental data. The experimental work of the present paper consists in the first place in the determination of the sources of error and then in the examination of the equilibria: $CH_3{\cdot}CO_2Na + AgNO_3 \rightleftharpoons CH_3{\cdot}CO_2Ag + NaNO_3$; $(CH_3{\cdot}CO_2)_2Ba + 2AgNO_3 \rightleftharpoons 2(CH_3{\cdot}CO_2)Ag + Ba(NO_3)_2$; $(CH_3{\cdot}CO_2)_3La + 3AgNO_3 \rightleftharpoons 3CH_3{\cdot}CO_2Ag + La(NO_3)_3$. The equilibria were reached in all cases from both sides, and it is shown that the experimental data confirm the theoretical curves obtained from the mathematical consideration. It is shown that the degree of subdivision of the solid phase is of first importance in determining the velocity and the sharpness with which the equilibrium is attained. The stability of silver acetate in contact with water and aqueous solutions depends on the purity of the salts used. The precipitation of barium sulphate in the presence of silver salts shows that the amount of silver salt occluded depends on the size of the particles of the precipitate, the velocity of precipitation, and the concentration of the silver salt. J. F. S.

Nature of Secondary Valence. II. Partition Coefficients. HOMER W. SMITH (*J. Physical Chem.*, 1921, **25**, 204—263; see this journal, ii, 324).—An empirical method of eliminating disturbing influences of dissociation, association, etc., in the distribution of a substance between two immiscible liquids is described. The partition coefficients of a large number of organic acids and bases between water and xylene and water and chloroform were determined. Attempts to connect these values with molecular volume are described. The observed points fall into several series, each of which is a straight line. These series are all parallel. The distances which separate several series are related to one another in a definite and periodic manner. J. R. P.

A Theory of Chemical Reactivity. Calculation of Rates of Reactions and Equilibrium Constants. SAUL DUSHMAN (*J. Amer. Chem. Soc.*, 1921, **43**, 397—433).—A theoretical paper in which a new theory of unimolecular reaction velocity is propounded after a critical discussion of the theories of Trautz, Lewis, and Langmuir. From the law of variation of reaction velocities with temperature, and from dimensional considerations, the velocity constant of a unimolecular reaction must be a frequency, and must satisfy a relation of the form $k_1 = \nu\epsilon^{-Q/RT}$ where ν is a frequency, $\epsilon^{-Q/RT}$ is the fraction of the molecules which are in the active state, and Q is the heat of activation. Assuming, with Lewis, that the process of activation is due to the absorption of radiation of a definite frequency, in quanta, it follows that the heat of activation per mol., $Q_A = Nh\nu_A$, where N is the number of molecules per mol., $= 6{\cdot}062 \times 10^{23}$, h is Planck's constant, and ν_A is the vibration frequency of the atoms. Now the frequency

ν above denotes the rate at which the active molecules decompose, and is probably related to the potential energy of the constituent atoms, that is, to the heat of activation. The author assumes that $\nu = \nu_A = Q_A/Nh$, and so arrives at the equation for the velocity constant of a unimolecular reaction $k_1 = Q_A/N_H \cdot \epsilon^{-Q_A/RT}$. By a simple transformation, introducing the known values of R, N, and h, this equation becomes $\log k_1 = 10{\cdot}0203 + \log Q_A - Q_A/4{\cdot}571T$. It follows that, from a single determination of the velocity constant at a given temperature it should be possible to calculate the heat of activation, or vice versa. This equation is tested against Trautz and Bhandarkar's figures for the dissociation of phosphorus hydride, PH_3, the only unimolecular reaction so far investigated which is free from the catalytic effect of the walls of the vessel, and the heat of activation found had a mean value of 72,750 cal. between 918° and 956° Abs. against 75,000 to 81,000 calculated from the temperature coefficient of k_1 by van't Hoff's equation (compare A., 1919, ii, 277).

For bimolecular reactions of the type $A + B \rightleftharpoons AB$, Jean's formula for calculating the frequency of collisions of active molecules is applied, and the following equation is deduced:

$$k_2 = N\sigma^2\sqrt{8\pi RT(1/M_A + 1/M_B)}, \epsilon^{-\frac{(Q_A+Q_B)}{RT}},$$

in which σ is the mean diameter of the molecules, M_A and M_B are the molecular weights of A and B, and $(Q_A + Q_B)$ the total heat of activation. This equation agrees well with experimental data for the reactions $H_2 + I_2 \rightleftharpoons 2HI$ and $2N_2O \longrightarrow 2N_2 + O_2$.

Equations are also deduced for several types of reversible reaction connecting the equilibrium constant K with the total heat of reaction Q. For example, for the reaction $A_2 + B_2 \rightleftharpoons 2AB$ the equation has the form $\log K = -Q/4{\cdot}57T + 0{\cdot}5 \log (M_{A_2} . M_{B_2})/4M^2_{AB}$. From the available data on homogeneous gas reactions, heats of reaction are calculated from these equations and agree, in a large proportion of cases, with the observed values.

In a discussion of heat of activation in dissociation reactions, it is shown, on general grounds, that the heat of activation must range between 40,000 and 100,000, and can be calculated approximately from the formula $\log Q_{AB} - Q_{AB}/4{\cdot}57T = -11$. It is generally assumed that in the reaction between activated atoms or molecules every collision is effective, but this may not always be the case, particularly with complex molecules, where steric factors may come into play. This may account for some of the discrepancies found between theory and experimental data.

It is concluded that the above equation for unimolecular reactions is of fundamental significance, although it does not lay claim to strict validity, but is probably influenced by at present unknown factors. The values calculated for the frequency term ν from the heat of activation correspond with a frequency in the visible or ultra-violet portion of the spectrum, supporting the conclusion that in chemical reactions the electrons play the fundamental rôle.

E. H. R.

Affinity of the Aragonite–Calcite Transformation. Hans L. J. Bäckström (*Zeitsch. physikal. Chem.*, 1921, **97**, 179—228).—The solubility of Iceland spar and synthetic aragonite in water in the presence of carbon dioxide of measured pressure (777—742 mm.) has been determined with an accuracy of 0·1% at 9°, 25°, and 35°. The values obtained for calcite were 1·30, 0·943, and 0·765 grams per litre at the three temperatures respectively, and for aragonite 1·46, 1·066, and 0·876 grams per litre respectively. The curves representing the reaching of equilibrium show, for Iceland spar at all temperatures and for aragonite at the lowest temperature, an unusual course, inasmuch as over a considerable portion the reaction velocity is practically zero. Powdered Iceland spar also shows a change with time, since the velocity of reaction in the course of the experiment gradually decreases. It is concluded that in the present case the Noyes-Nernst law, for the velocity of reaction in heterogeneous systems, does not hold. The heat of transition is calculated to -670 cal. ± 100, whilst the directly determined value of Le Chatelier is -600 cal. (A., 1893, ii, 259) and the transition point $-43° \pm 5°$. With increase in pressure, the transition point increases 1° per 40 atm. Hence pure aragonite can never constitute the stable phase in ordinary circumstances. Previous work on this subject is fully discussed. Compare Seyler and Lloyd (T., 1909, **95**, 1347), Bjerrum and Gjaldbæk (*Vet Landbohöjskole Aarskrift Kopenhagen*, 1919, 48), Foote (A., 1900, ii, 541), Kendall (A., 1916, ii, 512) and Warynski and Kouropatwinska (A., 1916, ii, 605). J. F. S.

Experimental Investigation of the Point of Inflammation and the Velocity of Reaction of a Hydrogen Oxygen Mixture. Hermann Fiesel (*Zeitsch. physikal. Chem.*, 1921, **97**, 158—178).—The point of inflammation is defined as that temperature at which the velocity of reaction exceeds a measurable value. The point of inflammation of various mixtures of hydrogen and oxygen has been ascertained by bringing both gases to the required temperature and then mixing and ascertaining by means of a delicate membrane whether a pressure difference occurs and therefore whether rapid reaction has occurred. The minimum inflammation point lies at 397·5° for the mixture of hydrogen and oxygen ($3H_2 + 2O_2$); for equal volumes of the dry gases the value is 407°, and increases after the minimum to 433° for the mixture ($4H_2 + O_2$). In the case of acetylene–air mixtures, the inflammation point could be only approximately determined. It is shown that it is possible by the method described to determine the velocity coefficient (kt) of the absolute velocity of a gas reaction, provided that it takes place sufficiently rapidly and is exothermic. It is shown that the reaction between moist oxygen and hydrogen is bimolecular, and may proceed through hydrogen peroxide, whilst when absolutely dry gases are used the reaction is trimolecular. It is probable, but not actually established, that the apparent catalytic action of the water vapour depends mainly on a concentration change of the mixture, for it follows from the equation $v = kC_1^{n_1} \cdot C_2^{n_2}$ that if the concentration is changed by admixture with indifferent gas, the quantity v, and

therefore *kt*, must have a definite value for each temperature and the inflammation temperature will therefore be increased. A possibility of ascertaining the heat of formation of hydrogen peroxide by the present method of experiment is indicated. J. F. S.

The Influence of Copper on the Rate of Solution of Iron in Acids. FREDERICK K. BELL and WALTER A. PATRICK (*J. Amer. Chem. Soc.*, 1921, **43**, 452—465).—Experiments were made with alloys containing 0·1%, 0·3%, 0·5%, 1·0%, and 5% of copper to determine the effect of copper on the rate of solution of the iron in acids. The iron for the alloys was prepared by reduction of pure ferric oxide; the copper used was pure copper foil. On account of the slow rate of solution in dilute acids, the experiments were limited to more concentrated acids, 28·7% hydrochloric and 57·0% sulphuric acid. The experiments were carried out by exposing a polished surface of the metal to the action of the acid and measuring the rate of evolution of hydrogen. In hydrochloric acid, the rate of solution of the alloys showed a definite decrease in comparison with pure reduced iron, the first 0·5% of copper having the greatest effect, further increase in the copper content of the alloy only slightly increasing the resistance. It was found that mere contact with copper wire brings about a marked reduction in the rate of solution of pure reduced iron in hydrochloric acid, whilst platinum and silver are without effect. The results of the experiments in sulphuric acid were too erratic to be of any value. To explain the retarding effect of copper, it is suggested that a certain amount of copper passes into solution, and is at once reprecipitated in a finely divided state on the surface of the iron, to be redissolved by the acid. This intermittent solution and precipitation of the copper may be responsible for its retarding effect. E. H. R.

The Velocity of Hydration of Anhydrides of Dicarboxylic Acids. I. P. E. VERKADE (*Rec. trav. chim.*, 1921, **40**, 192—198).—In this introductory paper the author discusses various theories which have been proposed as to the hydration of anhydrides of dicarboxylic acids. He considers that it is possible that the hydration may take place in two stages, in the first of which the anhydride unites with water to form an additive product, which in the second stage may pass to the acid with a relatively greater velocity (compare A., 1916, ii, 234, 607). He urges the desirability of determining the velocities of hydration of a large number of anhydrides of dicarboxylic acids. W. G.

The Velocity of Hydration of Anhydrides of Dicarboxylic Acids. II. Methylated Succinic Anhydrides. P. E. VERKADE (*Rec. trav. chim.*, 1921, **40**, 199—221. Compare preceding abstract and Rivett and Sidgwick, T., 1910, **97**, 732, 1677).—The author has redetermined the velocity of hydration of the anhydrides of succinic acid and of the mono-, di-, tri-, and tetra-methylsuccinic acids and in most cases the dissociation constants of the acids. For *as*-dimethylsuccinic anhydride the value $0{\cdot}4343k_{25} = 0{\cdot}0762$ is given for the velocity of hydration; for trimethylsuccinic

anhydride $0.4343k_{25} = 0.0783$; and for tetramethylsuccinic anhydride $0.4343k_{25} = 0.00638$. W. G.

The Hydrolysis of Carbamide Hydrochloride. GEORGE JOSEPH BURROWS (*J. Roy. Soc. New South Wales*, 1919, **53**, 125—135).—The degree of hydrolysis of carbamide hydrochloride of different concentrations in mixtures of water and ethyl alcohol and water and acetone has been determined (compare Burrows and Fawsitt, T., 1914, **105**, 612). The determinations were made by measuring the rate of inversion of sucrose, first by hydrochloric acid alone in the mixed solvents, and then in presence of the required amount of carbamide, a correction for the influence of unhydrolysed hydrochloride being applied in the manner adopted by Walker and Wood (T., 1903, **83**, 484). In water–alcohol mixtures the degree of hydrolysis decreases with decreasing concentration of water. The hydrolysis constant H at 25° was calculated from the formula $H = h^2/(1 - h)_v$ where h is the degree of hydrolysis and v the volume in litres containing one gram-molecule of carbamide hydrochloride. The experiments at different concentrations indicate that in water–alcohol mixtures the effect of dilution may be expressed by the ordinary dilution law. The amount of hydrolysis depends on the concentration of salt in the total volume, and is not simply proportional to the amount of water present. In the case of acetone–water mixtures, however, the value of the hydrolysis constant is approximately proportional to the number of molecules of water in solution, the acetone apparently having no hydrolytic effect. E. H. R.

Time Factor in Saponification. PERCIVAL J. FRYER (*Analyst*, 1921, **46**, 87—90).—The velocity of the saponification of oils and fats, from the point of view of the amount of free alkali removed from the reacting solution, is in inverse ratio to the mean molecular weight of the fatty acids of the glycerides composing the natural oils and fats. In terms of the weight of oil or fat employed, results were obtained showing that all oils and fats, and probably all esters, are saponified at approximately equal rates under the same conditions. The velocity of saponification is very greatly influenced by small differences in temperature, and is increased in direct proportion to the molecular weight of the solvent employed; thus the velocity in ethyl alcohol is more than ten times that in methyl alcohol, and in amyl alcohol is about double that in ethyl alcohol. It is also increased by increase in the concentration of the alkali. W. P. S.

Kation Catalysis. IV. BROR HOLMBERG (*Zeitsch. physikal. Chem.*, 1921, **97**, 134—157. Compare A., 1913, ii, 942).—It is assumed that the kation catalysis in a reaction between two strong electrolytes MAR and MB depends on the fact that the substance MAR, in which the reacting radicle constitutes only a portion of the corresponding anion, reacts more rapidly when un-ionised than when in the ionic condition, whilst the electrolyte MB, in which the anion is identical with the negatively charged reacting radicle,

reacts practically with equal rapidity as molecule and as ion. If α is the degree of ionisation of the first electrolyte, the formula $C = C_i\alpha + C_m(1 - \alpha)$ is obtained. To test this formula and the assumptions on which it is based, the velocity of the reaction between various thiocyanates and iodoacetic acid in neutral and acid solutions has been examined at 25°. It is shown that with a constant potassium concentration the reaction represented by the equation $CH_2I{\cdot}CO_2K + KSCN = SCN{\cdot}CH_2{\cdot}CO_2K + KI$ is a reaction of the second order. With increasing potassium concentration, the velocity constant is greater and may be represented by the formula $C = 2{\cdot}60[K]^{0{\cdot}197}$ and less well by the formula $C = 1{\cdot}24 + 4{\cdot}04[K]$. The experimental data are exactly reproduced by the expression $C = C_i\alpha + C_m(1 - \alpha)$, in which $C_i = 1{\cdot}12$, and $C_m = 4{\cdot}19$, corresponding with $k = 0{\cdot}04$. The values $k = 0{\cdot}6$, $C_i = 1{\cdot}15$, $C_m = 5{\cdot}04$, and $k = 0{\cdot}2$, $C_i = 1{\cdot}06$, and $C_m = 3{\cdot}32$ are also usable. In the case of sodium salts it is found that $C = 2{\cdot}46[Na]^{0{\cdot}17} = 1{\cdot}35 + 2{\cdot}8[Na] = 1{\cdot}12\alpha + 4{\cdot}25(1 - \alpha)$ for $k = 0{\cdot}4$ and for $k = 0{\cdot}2$, $C = 1{\cdot}06\alpha + 3{\cdot}30(1 - \alpha)$. Ammonium salts conform to the equation $C = 2{\cdot}66[NH_4]^{0{\cdot}167} = 1{\cdot}49 + 3{\cdot}0[NH_4] = 1{\cdot}12\alpha + 5{\cdot}16(1 - \alpha)$ for $k = 0{\cdot}4$ and for $k = 0{\cdot}2$, $C = 1{\cdot}06\alpha + 3{\cdot}92(1 - \alpha)$. Neither equation in the last case is particularly good. In the case of barium salts the equation $C = 3{\cdot}12[ba]^{0{\cdot}161}$ was obtained. In solutions to which hydrochloric acid had been added the velocity constant is independent of the initial concentration and also of the concentration and nature of the metal kation. The constant found for the reaction between non-ionised iodo-acetic acid and the thiocyanate in any form is $C_{m(\text{acid})} = 5{\cdot}72$. When free iodoacetic acid is used without the addition of hydrochloric acid, the velocity constant is also independent of the concentration and nature of the metal, but it increases with increasing initial concentration of the iodoacetic acid and can be calculated from the dissociation of the acid by the values $C_i = 1{\cdot}12$ and $C_{m(\text{acid})} = 5{\cdot}72$. It is then found that the calculated C values are about 2% smaller than the experimental values; this is, however, explained by the fact that the thiocyanic acid produced is a stronger acid than iodoacetic acid and that the ionisation of this acid is therefore decreased and the velocity of reaction increased. A definite progression of the velocity coefficients was not obtained, but this was the case when one half of the iodoacetic acid was neutralised with potassium hydroxide. In general it is shown that the assumptions made are in keeping with the experimental data. J. F. S.

The Influencing of Catalysts, and Specifically Active Catalysts. KARL W. ROSENMUND and F. ZETZSCHE (*Ber.*, 1921, **54**, [*B*], 425—437).—In a previous communication (A., 1918, i, 300) the author has described the preparation of aldehydes by the reduction of acid chlorides dissolved in dry xylene or cumene with hydrogen in the presence of palladinised barium sulphate. The yields, although frequently very good, are nevertheless uncertain and a systematic study of the effect of adding small quantities of foreign materials to the solvent is now recorded. With pure benzoyl

chloride dissolved in pure boiling benzene, toluene, or cumene a scarcely weighable amount of benzaldehyde was produced; the effect of thiophen bromide, distilled or crude quinoline, quinoline boiled with one-sixth of its weight of sulphur under a reflux condenser for five to seven hours, thioquinanthrene, quinine, quinine hydroiodide, dimethylaniline, benzthiazine, phenylthiocarbimide, diphenyl disulphide, and the by-products from the preparation of the latter, was investigated, an increase in the yield of aldehyde being obtained in practically every instance and reaching its maximum in the case of "sulphured" quinoline. It is remarkable that reduction appears to stop at the aldehyde stage, instead of continuing to formation of the alcohol or hydrocarbon, and this seems to be the first case on record in which a specific catalyst has been artificially produced by the addition of a chemically well-defined substance. Under similar treatment, *o*-chlorobenzoyl chloride gives *o*-chlorobenzaldehyde, and *p*-nitrobenzoyl chloride is converted into *p*-nitrobenzaldehyde, the yields being more than 70% and 91% respectively. Phenylacetaldehyde is obtained in 80% yield from phenylacetyl chloride.

The mechanism of catalysis in general is fully discussed. The catalyst is assumed to react with all the components of the system, thereby forming a "complex" with a characteristic distribution of energy and molecules; this is a labile physical or chemical arrangement, for the decomposition of which the arrangement of forces with which the members of the "complex" act on one another, which is determined by the catalyst, is responsible. Catalysts can be influenced in their activity by sundry addenda in the direction (*a*) of the strengthening or weakening of the catalyst, thus giving the possibility of selective catalysis, and (*b*) the mode of action thus rendering possible selective action. The combination of (*a*) and (*b*) leads to the preparation of specific catalysts.

A substance which by itself is inactive or only feebly active can attain the properties of a catalyst after addition of other suitable substances. H. W.

Effect of Temperature on the Catalytic Power of Platinum and Palladium Sols. ANTONIO DE GREGORIO ROCASOLANO (*Anal. Fís. Quím.*, 1920, **18**, 308—317. Compare A., 1920, ii, 479, 607).—The decomposition of hydrogen peroxide by sols of platinum and palladium was studied at various temperatures. The decomposition curves showed a continuous increase of catalytic power up to the boiling points of the sols. This controverts earlier statements that the sols of these metals lose their catalytic power at their boiling points. According to the author, the catalytic activity of metallic sols resides in the metal–oxygen complexes, and as long as these are undecomposed, catalytic power is unaffected. Metallic dispersions are much more stable than organic dispersions, and up to the point of their decomposition their activity increases with temperature. G. W. R.

Twenty-seventh Annual Report of the Committee on Atomic Weights. Determinations Published during 1920. GREGORY PAUL BAXTER (*J. Amer. Chem. Soc.*, 1921, **43**, 383—390).

—Papers published during 1920 dealing with atomic weight determinations are summarised. E. H. R.

Spiral Classification of the Elements. L. BEAUMONT TANSLEY (*Chem. News*, 1921, **122**, 121—122).—Taking the atomic weight of uranium as centre, the elements are plotted radially, the 18 sub-groups being allotted 20° each of the complete circle. J. R. P.

A Law of Force giving Stability to the Rutherford Atom. J. MARSHALL (*Proc. Roy. Soc. Edin.*, 1920, **40**, 150—157).—A mathematical paper in which it is shown that if a law of force between a positive nucleus and a negative electron be of the form $1/r^2 - (b^{n-2}/r^{n-2})$ an n value can be found which will preserve the stability of a group of electrons, not exceeding seven in number, rotating round a positive nucleus in a circular orbit. Since b, a constant, is smaller than the radius of the atom, for distances large in comparison with the radius of the atom this law of force will differ from the inverse square law by a negligible quantity. Stability for the simple cases of the Rutherford atom will therefore be established. The question of the stability of a series of rings of electrons rotating about a positive nucleus introduces complexity into the rigorous analysis required. If the tentative assumption is made that, so far as the effect of an inner set of rings on the outer ring is concerned, they may be replaced by an equivalent charge at the centre of the atom, the conditions for the stability of an outer ring of p electrons rotating in a circular orbit will be determined by the equations $4p(1 - sk/p) > \sum_{t=1}^{p-1} \operatorname{cosec}^3 t\alpha \sin^2 kt\alpha$ and the reality of the roots of the equation $(F - q'^2)(G - q'^2) = (H - Jq')^2$, where $F = \sum_{t=1}^{p-1} \frac{1}{8}[5 \operatorname{cosec} t\alpha - \operatorname{cosec}^3 t\alpha + \cos tk\alpha(\operatorname{cosec} t\alpha + \operatorname{cosec}^3 t\alpha)] - p[3 - (n+1)sk/p]$; $J^2 = 4p(1 - sk/p) - \Sigma \operatorname{cosec} t\alpha$. In these conditions sk/p replaces k; and since $s > p$, the new value of k will be less than the previous value. This can be obtained, since r is greater for the outer set than for any one of the values of r for the inner set, the value of n being kept the same; or n may be increased as well as r and the increased value of n will still maintain the stability of the inner set. The displacements of the electrons in the outer ring perpendicular to the plane of the orbit will be unstable, however, when p exceeds seven. This would indicate that an atom could be built up of a series of rings of seven electrons, and a periodicity in the properties of the atoms corresponding with the periodic classification would be expected from such a structure. J. F. S.

State of Aggregation of the Elements and the Atom Model. F. A. HENGLEIN (*Zeitsch. Elektrochem.*, 1921, **27**, 28—30).—On the basis of the Stark theory of intramolecular and intermolecular linking together with the Kossel atomic model (Stark, "Prinzip. Atomdynamik," III., p. 3; Kossel, A., 1916, ii, 243), it is shown

that the state of aggregation of the elements may be simply represented. Thus the electrostatic force of attraction of the positive nucleus of an atom on its valency electrons increases in the horizontal series of the periodic system with increasing atomic number, and in the vertical groups decreases with increasing atomic number. The force of attraction of the atoms for one another increases in the same sense. In the first four groups of the periodic system this affects only the intramolecular linking, whereby the monatomic character of the elements results, and also, according to the strength of the force, their state of aggregation. In the fifth, sixth, and seventh groups, the forces lead to molecule formation, whereby some force is left over which leads to intermolecular linking and thereby the gaseous, liquid, and solid conditions of the elements are conditioned. In the case of the inactive gases, forces act from the positive nucleus on the valency electrons and produce a new configuration. The valency electrons are drawn by the strong force into the inner electron system, and since only feeble molecular forces are present these elements remain gaseous at very low temperatures. J. F. S.

Bohr's Model of the Atom and the Corpuscular Spectra. MAURICE DE BROGLIE and LOUIS DE BROGLIE (*Compt. rend.*, 1921, **172**, 746—748. Compare this vol., ii, 232).—A theoretical discussion of work previously published (*loc. cit.*). W. G.

Atomic Structure and Scattered Radiation. R. GLOCKER and M. KAUPP (*Ann. Physik*, 1921, **64**, 541—565).—Debye's formula (*Ann. Physik*, 1915, **46**, 809) for the intensity of radiation scattered by an atom containing a single electron ring is extended to atoms containing two or three rings. For long waves, the intensity of scattering is still proportional to the square of the total number of electrons in the atom. The carbon atom with six electrons may have one ring of 6 electrons, two rings of 2 and 4 electrons, or two rings of 3 and 3 electrons. The inner K-ring of 2 electrons corresponds with the position of carbon in the periodic system, but the K-ring of 3 electrons is required to give the correct position of the K_α line. Experimental results are shown to favour the inner ring of 2 electrons and outer ring of 4 electrons, although a tetrahedral arrangement of the 4 electrons gives the same result. A single ring of 6 electrons is not admissible. The 13 electrons of the aluminium atom may be divided among the three rings, beginning with the inner, in the proportions 2, 8, and 3, or 3, 9, and 1. Both cases satisfy the experimental results. The validity of Barkla's law for the scattering of radiation is called into question. J. R. P.

Atomic Nuclei. E. GEHRCKE (*Physikal. Zeitsch.*, 1921, **22**, 150—152).—On the basis of a slightly modified nitrogen nucleus (Rutherford, A., 1920, ii, 541), the author has put forward nuclei for carbon, oxygen, neon (20), neon (22), chlorine (35), chlorine (36), chlorine (37), chlorine (38), and chlorine (39). J. F. S.

Homochemical Compounds. P. P. von Weimarn (*Kolloid Zeitsch.*, 1921, **28**, 97—103).—A theoretical paper in which it is deduced that all atoms have a minimum valency of six, and when a given atom combines with less atoms of hydrogen or oxygen than this number demands, the fact is due to properties of the surface of the atom and to the strength of the linking in the hydrogen and oxygen doublets. It is also stated that every substance, under suitable conditions, is capable of forming homochemical compounds with every other substance which contains a similar atom or atomic grouping to that substance. J. F. S.

Nature of Secondary Valence. I. Homer W. Smith (*J. Physical Chem.*, 1921, **25**, 160—169).—Secondary valence is defined as the force which binds molecules together. Evidence is presented from a study of organic compounds to show that the views that secondary valence is due to stray force-fields or to attractions operating according to some mathematical power of the distance are erroneous. The forces acting between molecules are comparable to those forces in the atom which are responsible for atomic structure, in that they are rhythmic in nature and are not subject to ordinary electromagnetic laws. Every molecule behaves as though it completely fills a definite space which has a three-dimensional symmetry. It is stated that in any series of compounds having the same intrinsic intensity of secondary valence the partition coefficient is a simple logarithmic function of the molecular volume. J. R. P.

Active Cross-section of Gas Molecules for Slow Electrons. Carl Ramsauer (*Ann. Physik*, 1921, **64**, 513—540).—The active cross-sections of the molecules of various gases were determined by measurement of the absorption of slow (1 volt) electrons of definite speed and direction at low pressures. The following values in cm.$^2 \times 10^{-18}$ were found: hydrogen 1260; argon 75; nitrogen 920; helium 550; air 890. These values are the following multiples of those calculated from the kinetic theory: hydrogen 3·4; argon 0·14; nitrogen 1·4; helium 2·3; air 1·4. The results with argon were less certain than the others, hence the conclusion is drawn that an electron is either absorbed outright or is not influenced in any way as regards the magnitude and direction of its velocity by a gas molecule. There is for every atom or molecule a fixed sphere of action outside which a slow electron is not influenced, but inside which it is strongly influenced. That the action is one of rapidly diminishing distance action is improbable by reason of the constancy of section found with such an electrostatically "open" structure as hydrogen. The question as to whether the phenomenon is to be explained by a division of atomic energy into quanta or to a spatial discontinuity of the electromagnetic field is left open. J. R. P.

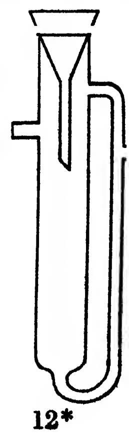
A New Method of Measuring Molecular Weights. J. G. Stephens (*J. Roy. Soc. New South Wales*, 1919, **53**, 166—170).—The method is based on the principle that, if two solutions containing different substances in solution in the same solvent are

together in a confined space, solvent will distil from one to the other until the vapour pressures are equal. When the vapour pressures are equal, the osmotic pressures are also equal, in other words, the molecular concentration is the same in each solution. The apparatus used consists of an inverted Y-tube; two test-tubes are ground into the two arms and the stem is provided with a stop-cock. In one test-tube is placed a known weight of a substance of known molecular weight in a known weight of solvent, and in the other a known weight of the substance the molecular weight of which is to be determined, also in a known weight of the same solvent. The apparatus is evacuated and allowed to remain until the weights of the two tubes have become constant. From the weight of solvent and solute in each tube the unknown molecular weight can then be calculated. Good results were obtained using benzene as solvent, but ethyl ether was not so satisfactory. E. H. R.

A Bunsen Burner Constructed from Glass Tubing. O. RUDOLPH (*Chem. Zeit.*, 1921, **45**, 289).—A burner giving a very small flame may be constructed from glass tubing by making a lateral opening, of the same diameter as that of the tube, in the lower part, for admission of air, and constricting the diameter of the tube below this opening to $\frac{3}{4}$ mm. for the gas passage. W. J. W.

Apparatus for Drying Substances which are Unstable at High Temperatures. O. RUDOLPH (*Chem. Zeit.*, 1921, **45**, 289).—An apparatus specially adapted for drying explosives or hygroscopic substances, consists essentially of a desiccator, which contains no desiccating agent; this is heated to the desired temperature in a water-bath, the air being at the same time nearly exhausted by means of a suction pump. A slow current of heated, dry air is then drawn into the apparatus through a leaden worm placed in the water-bath and leading into the desiccator through its tubulure, this worm being in communication with the calcium chloride drying tubes. The pressure maintained in the apparatus, as indicated by a manometer, should exceed the vapour tension, at the given temperature, of the vapour to be expelled by about 10 mm. The current of vapour-laden air passes out through a tube surrounding the inlet tube (or through a second tubulure if there be one) to absorption vessels. W. J. W.

The Automatic Separator in Esterifications and Other Preparations. I. N. HULTMAN, ANNE W. DAVIS, and H. T. CLARKE (*J. Amer. Chem. Soc.*, 1921, **43**, 366—370).—The separator is as sketched and forms a ready means of continuous separation of two immiscible liquids. If used in the distillation of a mixture of two such liquids, the distillate being collected in this apparatus, by suitable connexions it can be arranged that the heavier or lighter liquid, as desired, returns automatically to the distillation flask, whilst the other runs off to a receiver. Examples of its utility in various preparations are given. W. G.



Inorganic Chemistry.

Density of Hydrochloric Acid. J. FITCH KING (*J. Physical Chem.*, 1921, **25**, 115—121).—Discrepancies exist in published densities of 2*N*-hydrochloric acid. The value D_4^{15} 1·0344 was found. The concentration coefficient at this concentration, dD/dC, is 0·004986, and the temperature coefficient dD/dt is 0·000250.

J. R. P.

Preparation of Chlorine Heptoxide. FRIEDRICH MEYER and H. G. KESSLER (*Ber.*, 1921, **54**, 566—571).—A mixture of chlorine heptoxide and pyrosulphuryl chloride containing a little chlorine peroxide is obtained when a mixture of potassium perchlorate (3 parts) and chlorosulphonic acid (5 parts) is gradually heated to 70—75° in the vacuum of a water-pump; pale yellow chlorine heptoxide (98—99%) is prepared by the distillation of this product in a vacuum, but traces of sulphur compounds are obstinately retained even after repeated re-distillation. The process is almost without danger. Solutions of chlorine heptoxide in carbon tetrachloride are readily obtained by conducting the mixed gases obtained in the above process in succession into an empty receiver cooled to − 20° in which nearly all the pyrosulphuryl chloride condenses, and then into a second vessel, also cooled to − 20°, containing carbon tetrachloride, which dissolves the chlorine heptoxide and peroxide. The latter can be removed by gently boiling the solution and the residual liquid then retains only pyrosulphuryl chloride, chlorosulphonic acid, and sulphur trioxide as impurities, the total amount being 1—2% as a maximum.

Chlorine heptoxide in a higher state of purity can be obtained by the very cautious addition of phosphoric oxide to strongly-cooled perchloric acid (70%) in such a manner that the heptoxide can ultimately be distilled, but local overheating cannot be avoided and the yields are poor. The components can be safely brought together if previously absorbed by or mixed with purified and ignited kieselguhr or "K-silicic acid" (of the Elektro-Osmose Akt. Ges.); the adsorptive capacity of the material is such, however, that only a portion of the heptoxide is removed at about 80—90/0·2 mm. The yields are only about 10%, but the product is easily purified by distillation and the method is suitable when the substance is required in small quantity and high purity.

The preparation of pure solutions of chlorine heptoxide in carbon tetrachloride is effected as follows. Considerable amounts of phosphoric oxide are suspended in carbon tetrachloride, the suspension is cooled to 0° and violently stirred whilst perchloric acid (70%) is added drop by drop. The mixture is warmed and filtered, thus yielding a solution containing about 2·5% of chlorine heptoxide. If this solution is distilled as far as possible at 0° in a water-pump vacuum, a residue remains which contains about $\frac{1}{8}$ of the original carbon tetrachloride and 80% of the heptoxide. The vacuum is broken and the solution is digested at 70—75° and distilled in a

vacuum with a well cooled receiver up to 80°. If the product is warmed at 80°, a small distillate is obtained which contains the whole of the chlorine and chlorine peroxide, a colourless residue remaining in the flask. If more highly concentrated solutions are necessary, the residue is mixed with more phosphoric anhydride and perchloric acid and the process is repeated; thus, three successive treatments yield a solution containing 20—25% Cl_2O_7. H. W.

The Quadrupolar Moments of the Oxygen and Nitrogen Molecules. W. H. KEESOM (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 939—942).—The following magnitudes were calculated: the inversion temperature of the Joule-Kelvin effect for small densities for oxygen 450°, for nitrogen 331°; the potential energy of the molecules in contact, for oxygen $5{\cdot}71 \times 10^{-14}$, for nitrogen $4{\cdot}77 \times 10^{-14}$; the molecular diameter for oxygen $2{\cdot}65 \times 10^{-8}$, for nitrogen $2{\cdot}98 \times 10^{-8}$; the quadrupolar moment for oxygen $3{\cdot}55 \times 10^{-26}$ e.s.u. $\times$ cm.^{2}, for nitrogen $3{\cdot}86 \times 10^{-26}$. If oxygen possesses 14 magnetons per molecule, as assumed by Weiss and Piccard the moment would be $2{\cdot}6 \times 10^{-20}$; the value $9{\cdot}47 \times 10^{-19}$ is required to explain the molecular attraction, hence it is concluded that the contribution of the magnetic moment to the molecular attraction does not come into consideration. J. R. P.

Non-biological Oxidation of Elementary Sulphur in Quartz Media. W. H. MACINTIRE, F. J. GRAY, and W. M. SHAW (*J. Ind. Eng. Chem.*, 1921, **13**, 310—313; *Soil Sci.*, 1921, **11**, 249—259. Compare A., 1917, i, 723).—The results of the authors' experiments show that, although the transformation of sulphur added to the soil may be partly a function of the biological content of the soil, yet sulphur may be readily and extensively converted into sulphates by independent chemical action under aerobic or anaerobic, sterile or non-sterile conditions of moist contact at normal temperatures when ferric oxides and alkaline-earth carbonates are present. T. H. P.

Vapour Pressures of Hydrogen Sulphide. E. CARDOSO (*Gazzetta*, 1921, **51**, i, 153—164).—The author has prepared highly pure hydrogen sulphide and has measured its vapour pressure at a number of temperatures between 0° and 100·4°, which is the critical point. Expression of the results by means of Biot's formula, $\log p = a + b\alpha^t + c\beta^t$, necessitates tedious calculation, and the use of logarithms of α and β containing seven significant figures if its results are to be exact to 0·05 atmosphere. The author uses, therefore, two formulæ of the type $p = ae^{bt+ct^2}$: (1) For temperatures between 0° and 50°, $\log p = 1{\cdot}00860 + 0{\cdot}011935t - 0{\cdot}000026863t^2$ and (2) for temperatures between 50° and 100·4°, $\log p = 1{\cdot}53820 + 0{\cdot}0088786(t-50) - 0{\cdot}000014429(t-50)^2$, p being expressed in atmospheres. The two parabolæ corresponding with these exponential formulæ join perfectly at 50° and permit of extrapolation over $\pm$ 6°. The two formulæ admit of the immediate deduction of the following expressions for the first differential coefficient: (1) $dp/dt = p(0{\cdot}027481 - 0{\cdot}00012371t)$ and (2) $dp/dt = p[0{\cdot}020444 - 0{\cdot}000066449(t-50)]$. T. H. P.

The Cathodic Reduction of Dissolved Elementary Nitrogen. Erich Tiede and Arthur Schleede (*Zeitsch. Elektrochem.*, 1921, **27**, 112—114).—In 1807, Davy (*Phil. Trans.*, 1807, 1) claimed to have obtained nitric acid and ammonia by the electrolysis of distilled water containing dissolved air, but Lord Rayleigh (T., 1897, **71**, 181) failed to confirm this result. The authors have repeated the experiment under widely varying conditions, at pressures from atmospheric up to 150 atm., and have failed to obtain a trace of ammonia. E. H. R.

The Structures and Reactions of Hydroxylamine and its Derivatives. Arthur Michael (*J. Amer. Chem. Soc.*, 1921, **43**, 315—332. Compare A., 1920, i, 536).—A critical review of previous work and theories on this subject, with special reference to the work of Jones (A., 1914, ii, 559). The author is of the opinion that all the properties of hydroxylamine, its derivatives, and its salts conform with and can only be satisfactorily explained by the hydroxyl structure. There is as yet no indication of the existence of such products in tautomeric forms, which, for energy and affinity reasons, under ordinary conditions, should represent labile substances. No theoretical or experimental evidence is known pointing to the existence of hydroxylamine, its derivatives, salts, or hydroxylammonium products in "electromeric" modifications and the "electronic" explanations (Jones, *loc. cit.*) of the reactions of these compounds are not tenable. W. G.

Vapour Pressure of White Phosphorus from 44° to 150°. Duncan MacRae and C. C. van Voorhis (*J. Amer. Chem. Soc.*, 1921, **43**, 547—553).—The vapour pressure of white phosphorus, purified with the greatest care, was measured between 44° and 150°, using the static isoteniscope described by Smith and Menzies (A., 1910, ii, 1036). From the results obtained the equation $\log P = 7{\cdot}9542 - 2757{\cdot}5/T$ is derived, P being the pressure in mm. of mercury. The maximum error is as low as 0·5% from 100° to 150°, probably increasing at lower temperatures but not exceeding 5% at 44°. The values of the vapour pressure found are from 30—60% higher than those obtained by extrapolating the equation of Smits and Bokhorst, derived from measurements between 169° and 409° (A., 1916, ii, 317). They are not inconsistent, however, with the measurements of Centnerszwer on solid white phosphorus (A., 1913, ii, 1052). E. H. R.

Preparation of Boron by the Dissociation of Boron Bromide. Friedrich Meyer and R. Zappner (*Ber.*, 1921, **54**, [*B*], 550—560).—Pure boron has been prepared recently by Weintraub (A., 1912, ii, 43) by the reduction of boron trichloride by hydrogen in a high-tension arc, but the process is somewhat cumbersome and not generally available. A more convenient method consists in taking advantage of the dissociability of boron bromide in the high-tension arc.

The preparation of boron bromide, b. p. 90·5°, by the action of bromine vapour on crude boron (obtained from magnesium and

boric anhydride) at 700° is described. The earlier attempts to prepare boron from it were made by striking a high-tension arc between copper poles beneath the liquid, but the yields were unsatisfactory. Subsequently, the conditions were modified, and the arc was made in the gaseous substance. For this purpose two types of apparatus are described. For the preparation of small quantities of boron, the bromide is boiled in a small bulb directly attached to a large bulb, which holds the electrodes, and thence to a reflux condenser, the whole apparatus being made of glass with ground-in joints of such a type that a little of the boron bromide condenses on them, and so shields the remainder of the product from the lubricating material; with a tension of 100,000 volts, equilibrium is established in about five hours. If larger quantities are required, a more complex apparatus is used in which the boron bromide is vaporised in a flask, from which it passes over copper wool heated at 200° (to remove free bromine), thence through the vessel containing the electrodes, then to the condenser, from which the unattacked bromide is returned to the flask.

Boron obtained by this method is an exceedingly fine, deep black powder which gradually becomes oxidised on exposure to air, reacts violently with dilute nitric acid, and inflames on contact with the concentrated acid. H. W.

The Preparation of Considerable Quantities of Pure Boron Nitride. FRIEDRICH MEYER and R. ZAPPNER (*Ber.*, 1921, **54**, [*B*], 560—566).—The preparation is beset with considerable difficulties, since all processes which utilise boric anhydride as initial material give more or less poor yields of products which are contaminated with boric acid. The only suitable starting point is the additive compound of boron trichloride and ammonia which, when led through an intensely heated tube, yields boron nitride and ammonium chloride. The operations are greatly hampered by the fact that the compound, when prepared as usual at low temperatures, is an exceedingly voluminous substance, which requires inconveniently large apparatus when used on any considerable scale and further is very hygroscopic. In addition, a large portion of the boron nitride escapes with the ammonium chloride vapour and other products from which it cannot be separated readily. This is found to be due to the fact that, as the compound approaches the hot walls of the tube, it decomposes with the evolution of sufficient gas to prevent the nitride being deposited on the tube. This difficulty is overcome by adopting a zonal arrangement of heating the reaction tube, whilst the hygroscopicity is avoided and a compact product is secured by allowing the boron chloride and ammonia to react *in situ* at an elevated temperature. The apparatus consists of a quartz tube wound with nichrome wire in three zones; it is fitted with an arrangement for the admission of hydrogen, hydrogen charged with boron chloride vapour, and ammonia, and is provided with a platinum pyrometer. The other end of the tube is fitted to a glass vessel which serves for the collection of the ammonium chloride; this vessel can be heated electrically in such a manner that a uniform deposit of the salt is

secured, thus avoiding the easy choking of the tubes. After the whole apparatus has been dried in a current of hydrogen at 300°, the tube is heated at 500—600° and regulated streams of ammonia and hydrogen charged with boron chloride are admitted, the former always being in large excess. After complete admission of the reagents, the tube is further heated in alternate zones for five to six hours, after which the temperature is gradually raised to 1000° whilst a slower current of ammonia passes over the product.

As thus prepared (the yield is 80—85% calculated on the amount of boron chloride used), boron nitride is a colourless powder the density and stability towards water of which depend on the final temperature employed; at 800° and with a long period of experiment, a very voluminous product is obtained which after exposure to the atmosphere for some time emits the odour of ammonia. More intensely heated preparations are more stable to air.

H. W.

Force of Cohesion of the Diamond. HANS THIRRING (*Zeitsch. Physik*, 1921, **4**, 1—25).—A theoretical paper in which two hypotheses are put forward as to the position of the valency electrons of carbon in the diamond. (i) The electrons circulate in paths which lie in the middle between two neighbouring nuclei. (ii) All the electrons belonging to an individual nucleus lie inside a sphere, which surrounds the atomic nucleus, the radius of which is small in comparison with the crystal lattice constant. It is shown that the first hypothesis is only usable if the cohesion is explained by the electrostatic forces, and in this connexion the general nature of homo-polar compounds is discussed. J. F. S.

Silicon Hydrides. IX. Reactions with Alkali Metals. ALFRED STOCK and KARL SOMIESKI (*Ber.*, 1921, **54**, [*B*], 524—531).—The experiments were undertaken with the object of synthesising disilane by the action of alkali metals on monochlorosilane, but did not lead to the desired result.

Monochlorosilane reacts readily with potassium at the ordinary temperature, but the metal becomes coated with a protective layer which speedily inhibits reaction; at 300°, the change is complete, the products being silicon, potassium hydride, potassium chloride, and hydrogen. Further experiments were therefore performed with potassium–sodium alloys and with sodium amalgam, which are liquid at the atmospheric temperature; (the necessary apparatus and manipulation are fully described and illustrated in the original). With potassium–sodium alloy during a month, monochlorosilane gave only an incomplete reaction. The expected main product, disilane, could not be detected with certainty, and could have been present only in traces; the chief volatile product was monosilane, its volume being more than 60% of that of the chloro-compound used. Similar results were obtained with sodium amalgam; the chief products were monosilane mixed with a minor amount of hydrogen, but, in addition, the presence of disilane in small quantity was definitely established. The latter was shown to undergo slow decomposition in the presence of sodium–potassium alloy or of

sodium amalgam, with the production of hydrogen and monosilane. It is, however, obvious that disilane in the nascent state, probably as SiH_3, reacts far more readily with alkali metals than in the molecular form.

Methyl chloride behaves similarly to monochlorosilane towards sodium amalgam, giving methane (55%) and ethane (10%); the latter, however, is not noticeably attacked by alkali metals.

Dichloromonosilane is converted into monosilane and hydrogen by sodium amalgam.

The formation of silane and methane from their chloro-derivatives is not explained. The production of silane from disilane and sodium depends on the replacement of an atom of hydrogen by sodium and the subsequent reduction of a portion of the disilane by the nascent atom, whilst the remainder becomes condensed to non-volatile compounds. This hypothesis is supported by the observations that disilane is quantitatively reduced to monosilane by boron hydride, B_4H_{10}, which slowly decomposes at the ordinary temperature with liberation of hydrogen, and that the latter invariably accompanies monosilane in the experiments just described.

H. W.

Equilibria of Hydrofluosilicic Acid. LAWSON JOHN HUDLESTON and HENRY BASSETT (T., 1921, **119**, 403—416).

Silicic Acid. VICTOR LENHER (*J. Amer. Chem. Soc.*, 1921, **43**, 391—396).—Experiments were made on the hydration of silica with the view of obtaining further information on the chemical relations between silica and water. Silica in the form of sand containing more than 99·0% SiO_2 was ground until 85% of the particles had a diameter less than 0·004 mm. When left in contact with water for two or three weeks, this material went into solution to the extent of about 0·032 gram per litre. The solution was truly colloidal, exhibiting the Tyndall effect, whilst the particles showed a rapid Brownian movement. When heated under pressure in presence of excess of water at 300° to 450°, the same finely-divided silica formed a gel containing 15% to 18% of water. On the other hand, silica gels prepared by dialysis of a sodium silicate–hydrochloric acid mixture under similar treatment lost water, yielding a product still containing, however, 70% to 80% of water. The hydration of fused quartz or quartz crystals can be brought about in a similar way. The action of water on silica is therefore that of a solvent, producing a silica gel, and causing it to go into the colloidal form. The more finely divided the silica, the more rapid is the action. Attempts to obtain a definite hydrate of silica, or silicic acid, by subjecting silica gels to enormous pressures, were unsuccessful, and it is concluded that the silicic acids are purely hypothetical.

E. H. R.

Synthetic Helium and Neon. A. LO SURDO (*Atti R. Accad. Lincei*, 1921, [v], **30**, i, 85—88).—The author finds that neon, helium, and hydrogen are able to pass through hot glass, the hydrogen in far greater quantity than the other two gases. The

passage is dependent on the temperature, nature, and thickness of the glass. These results may furnish an explanation for the origin of so-called synthetic helium and neon, which may be derived from the atmosphere. T. H. P.

The Electromotive Behaviour of some Binary Alloys. XV. Alloys of Potassium with Lead, Tin, and Thallium, and of Sodium with Antimony. R. KREMANN and ERNST PRESZFREUND (*Zeitsch. Metallkunde*, 1921, **13**, 19—29).—Alloys of potassium and lead containing up to 33 atoms % of lead show the same *E.M.F.*, measured against a lead electrode, as pure potassium. When the formation of the compound K_2Pb is complete, there is a sudden drop of potential to a value which again remains constant up to a composition corresponding with KPb_4. The compound KPb_2, if it exists, must have practically the same potential as K_2Pb. The potassium–tin alloys were measured against a tin electrode, and the *E.M.F.* curve indicated the formation of the compounds K_2Sn, KSn, KSn_2, and KSn_4. In the case of potassium–thallium alloys, there is a marked tendency for surface layers of the less electropositive constituent to form, so that, in alloys of even the lowest thallium content, there is a marked drop from the potassium potential. Exact determinations of the potential of the compounds KTl and K_2Tl were therefore impossible. The *E.M.F.* curve for the sodium–antimony alloys shows only one step corresponding with Na_3Sb. The potential of this compound could not be distinguished from that of NaSb. E. H. R.

A New Crystalline Form of Potassium Chlorate. E. R. WOLCOTT (*J. Ind. Eng. Chem.*, 1921, **13**, 215—216).—Potassium chlorate may be obtained in the form of long, fibrous crystals of silky appearance by treating its aqueous solution with an aqueous solution of hydrocarbons. Equal parts of California crude oil (D 0·9359) and oleum are mixed and agitated for one hour, the temperature not being allowed to rise during the operation. After some hours, the tar-like substance formed is separated from the residual acid, and dissolved in hot water to give a 6 per cent. solution. Ten c.c. of this solution are then added to 200 grams of a saturated solution of potassium chlorate, the mixture is diluted to 800 c.c., boiled, filtered, and crystallised. Preliminary friction tests in a mortar seemed to indicate less sensitiveness with these crystals than with the normal form, but this result was not confirmed with the frictional pendulum. W. J. W.

Determination of Melting Points, Especially of Potassium Chlorate. C. D. CARPENTER (*Chem. and Met. Eng.*, 1921, **24**, 569—571).—A melting-point apparatus consists of a lagged beaker, with observation holes in the lagging, a platinum resistance thermometer, and a stirrer which can be rotated at various speeds. It is heated by a molten mixture of potassium and sodium nitrate (m. p. 220°), and for temperatures above 600° both the heating bath and melting-point tube should be of transparent quartz. In determining the melting point of potassium chlorate, the sub-

stance was melted and cooled several times, the range of temperature being kept within narrow limits, and crystals never being allowed to disappear completely. The temperatures at which new crystals formed on cooling were noted in terms of the resistance. The results plotted graphically gave a resistance of 116·425 ohms, corresponding with a melting point of 357·10°. W. J. W.

Preparation of Potassium Perchlorate. E. BLAU and R. WEINGAND (*Zeitsch. Elektrochem.*, 1921, **27**, 1—10).—The thermal and electrolytic preparation of potassium perchlorate from potassium chlorate has been examined. It is shown that by heating chemically pure potassium chlorate in glass flasks to 510° a good yield of the perchlorate may be obtained. In the presence of small quantities of potassium hydroxide, copper, nickel, iron oxide, or boron trioxide, the perchlorate commences to decompose whilst there is still much undecomposed chlorate present. When commercial chlorate is used, similar results are obtained. The reaction is most efficiently carried out in quartz flasks at 480° without a catalyst; after heating for eight hours, 69 grams of perchlorate are obtained from 100 grams of chlorate. It has been found impossible to decompose completely the chlorate, for the perchlorate commences to decompose to a marked extent when there is still 3—4% of the original chlorate present. This chlorate is readily removed by crystallisation. Iron utensils are quite unsuitable for this reaction. Potassium perchlorate can be formed by the electrolysis of a solution of potassium chlorate between a platinum anode and a nickel cathode, using a current density of 0·15 ampère/sq. dcm. A good current and material yield are obtained in the process. The process suffers from the defect that the electrodes, even with a rapidly circulating electrolyte, become incrusted with the perchlorate. With a current density of 0·1 ampère/sq. dcm. the current yield decreases if the temperature is raised above 20°, whilst with a greater current density even at 27° good yields are obtained. At 27°, the current yield increases greatly in increasing the cathodic current density, whilst a change in the anodic current density has practically no effect on the yield. If, instead of potassium chlorate, sodium chlorate is electrolysed, the very soluble sodium perchlorate is formed and this by double decomposition can be converted into potassium perchlorate by treatment with potassium chlorate. The mother liquors containing sodium chlorate are then electrolysed. In this way the incrustation of the electrodes is avoided. The electrolysis of solutions of barium chloride at 60° with a nickel cathode and a platinum anode, using a current density of 0·15 ampère/sq. dcm. gives barium perchlorate with a current yield of 50—60%. In this process the whole of the barium chloride is oxidised. The addition of acetic acid, hydrochloric acid, or calcium chloride or leading carbon dioxide into the solution are favourable to the reaction. J. F. S.

The Preparation of Sodium Hydroxide from Sodium Sulphate. BERNHARD NEUMANN and ERNST KARWAT (*Zeitsch. Elektrochem.*, 1921, **27**, 114—124).—The effects of temperature and

dilution on the equilibrium of the reaction $Na_2SO_4 + Ca(OH)_2 \rightleftarrows CaSO_4 + 2NaOH$ were studied with the object of determining the maximum yield of sodium hydroxide which could be obtained by the action of lime on aqueous sodium sulphate. The results of earlier workers were not trustworthy because true equilibrium had not been obtained; it was found necessary to apply continuous shaking for several days. From the solubilities and dissociation constants of the reacting substances, the equilibrium constant was calculated to be $K_{18} = 0 \cdot 388$, diminishing with rising temperature. The values actually found were of this order, but considerably lower, diminishing with increasing temperature or increasing concentration. The results of the experiments at 15°, 40°, 70°, and 100° are shown in a series of curves in which the "yield" of sodium hydroxide is plotted against the dilution of sodium sulphate taken. On each curve the yield is highest at the greatest dilution and at any dilution it is highest at the lowest temperature [compare *J. Soc. Chem. Ind.*, 1921, 257A]. E. H. R.

Preparation and Properties of Sodamide. J. M. McGee (*J. Amer. Chem. Soc.*, 1921, **43**, 586—591).—Sodamide melts sharply at 208° (compare Titherley, T., 1894, **65**, 504), and at 210° has a specific conductivity of $1 \cdot 665 \pm 0 \cdot 005$ mhos, using platinum electrodes (compare Wöhler and Stang-Lund, A., 1918, ii, 397). Values were not obtained above this temperature owing to catalytic decomposition of the amide by platinum into ammonia and either sodium imide or nitride. No blue solutions of sodium in the amide could be obtained (compare Titherley), and the solvent action on glass imputed to the amide by Titherley and others was probably due to sodium hydroxide, since no tendency of this kind was observed below 240°. At 270—300°, however, there was a slight action after two to three days. J. K.

Melting Point of Ammonium Sulphate. James Kendall and Arthur W. Davidson (*J. Ind. Eng. Chem.*, 1921, **13**, 303—304).—Widely divergent values have been given for the melting points of ammonium sulphate and ammonium hydrogen sulphate. For the latter salt, Kendall and Landon (this vol., ii, 45) found m. p. $146 \cdot 9 \pm 0 \cdot 5°$, Jänecke's value, 251° (A., 1920, ii, 757), being grossly inaccurate. The normal sulphate loses ammonia, even at 200°, so that determination of a true melting point in an open tube is impossible. When the salt is heated gradually in a sealed tube which it practically fills, it softens perceptibly at 490° and gives m. p. $513 \pm 2°$; this temperature represents, then, the definite melting point of normal ammonium sulphate under an ammonia pressure of considerably more than 1 atmosphere. Caspar's value, 417—423° (A., 1920, ii, 431), is thus erroneous, as also is Jänecke's statement (*loc. cit.*) that the normal sulphate has the same m. p. and b. p., 357°. T. H. P.

Colloidal Calcium Phosphate. G. M. de Toni (*Kolloid Zeitsch.*, 1921, **28**, 145—148).—Colloidal calcium phosphate may be prepared by adding, slowly and with continuous shaking, a hot

normal solution of sodium phosphate to an equal volume of a hot normal solution of calcium chloride containing a definite amount of a protective colloid. The colloidal solution is best obtained in the presence of gelatin, but may also be prepared in the presence of gum arabic, blood serum, and starch; in the presence of sucrose and caramel, the colloid is not produced. The amount of protective colloid controls the concentration of colloidal calcium phosphate present in the solution; thus with 9·5 grams of gelatin per litre the colloidal solution contains 2·068 grams of calcium phosphate, and with 27·5 grams of gelatin, 4·137 grams of calcium phosphate. The colloidal solution is practically opaque and is quite clear in transmitted light, but bluish-white in colour by reflected light. The gel is porcelain-white, with a faint blue tinge by reflected light. The individual particles are invisible under a magnification of 1800. The colloidal solution may also be obtained by the action of a solution of orthophosphoric acid on a solution of calcium hydroxide containing gelatin. The importance of colloidal calcium phosphate in therapeutics and its possible rôle in the processes of assimilation and digestion are indicated. J. F. S.

Transformation of Light Magnesia into the Dense Form. N. Parravano and C. Mazzetti (*Atti R. Accad. Lincei*, 1921, [v], **30**, i, 63—66).—The results of the authors' experiments show that the velocity of hydration of magnesium oxide diminishes as the temperature and duration of its previous calcination are increased, no discontinuity being observable. The statement that magnesium oxide undergoes transformation at about 1600° (Le Chatelier, *Le Chauffage*, 399) or 1100° (Campbell, A., 1918, ii, 364) is inaccurate, this change having already begun at the lowest temperature employed by the authors, namely, 800°, at which, however, it proceeds very slowly. This result is confirmed by Ditte's measurements of the density of the oxide after being heated at definite temperatures for a certain time (this Journ., 1871, 869). Natural magnesites contain impurities which exert a marked influence on the velocity of hydration of the oxide resulting from their calcination, the transformation into the dense modification being facilitated. This change is at first slow and continually increases in rapidity as the temperature is raised, and no definite transformation temperature probably exists. T. H. P.

Constitution of Alloys of Aluminium, Copper, and Zinc containing High Percentages of Zinc. John L. Haughton and Kathleen E. Bingham (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 47—69).—The thermal curves, microscopic appearance of annealed and quenched specimens, and the electrical conductivities were determined and the results represented by diagrams. J. R. P.

The so-called Oligodynamic Action of the Heavy Metals and of the Salts of the Heavy Metals. W. Falta and M. Richter-Quittner (*Biochem. Zeitsch.*, 1921, **115**, 39—41).—The oligodynamic action of various metals was tested in the following way: a test-tube was filled with water containing the respective metals and left for eight days. The metal and the water were

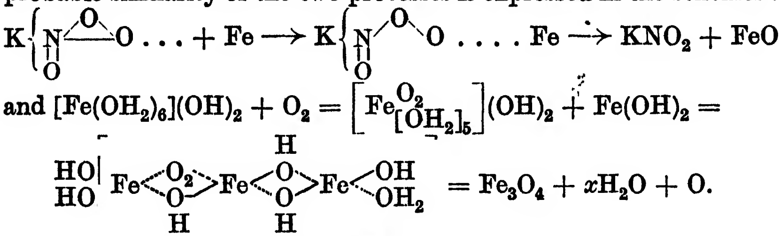
then removed, the test-tube rinsed out with distilled water, and its oligodynamic action tested on the different solutions. It was found that guaiacol, benzidine, resorcinol, and homogentisic acid were oxidised when kept in test-tubes prepared in the above way. Potassium permanganate was decolorised, with the formation of manganese dioxide. Methylene-blue, indigotin, and sodium indigotinsulphonate were decolorised and the leuco-base of malachite-green was oxidised. Protein solutions were coagulated through the oligodynamic action of the metals. The hydrolysis of starch was, however, not brought about in this way. This oligodynamic action was shown by the following metals, which are arranged in the order of their activity: copper, mercury, silver, lead, tin, aluminium, iron, magnesium, and platinum. S. S. Z.

The Reaction between Copper and Nitrogen Peroxide. HERMAN V. TARTAR and WALDO L. SEMON (*J. Amer. Chem. Soc.*, 1921, **43**, 494—500).—By the action of dry nitrogen peroxide on copper powder prepared by the reduction of cupric oxide in a stream of hydrogen or carbon monoxide, Sabatier and Senderens (A., 1893, ii, 374) obtained a product to which they ascribed the formula Cu_2NO_2. The authors have repeated this work, using powdered copper prepared (*a*) by the reduction of cupric oxide with hydrogen and (*b*) by the reduction of hydrated cuprous oxide, $4Cu_2O,H_2O$, with carbon monoxide. The hydrated cuprous oxide was prepared by precipitating a hydrochloric acid solution of cuprous chloride with sodium hydroxide solution, and the composition of the product so obtained confirmed the formula given by Mitscherlich to this substance. The copper reduced by hydrogen reacted immediately and at a fairly rapid rate with nitrogen peroxide, whilst that reduced by carbon monoxide only darkened after several hours, and took several days before the reaction was complete. The final gain in weight was variable in different experiments and the final product was a mixture containing much unchanged copper. The ratio of nitrogen to oxygen in the product immediately after withdrawing it from the gas was 1 : 3, but on exposure to the air loss of weight occurred, nitric oxide or nitrogen peroxide being evolved. The formula Cu_2NO_2 cannot be confirmed, and it is suggested that anhydrous cuprous nitrate is formed on the surface of the copper. At the same time, doubt is thrown on the existence of other compounds said to have been obtained by the action of nitrogen peroxide on metals. E. H. R.

The Action of Additions on the Anomaly of Dilatation of Ferronickels; Application to Iron–Nickel–Chromium Alloys. P. CHEVENARD (*Compt. rend.*, 1921, **172**, 594—596).—By plotting the total anomaly of dilatation, A_0, against the composition of pure ferronickels, a curve is obtained which rises rapidly with the nickel content from 25% nickel, reaches a sharp maximum at a point corresponding with the compound Fe_2Ni, and then descends rapidly to reach a value $A_0 = 0$ at about 58% nickel, when A_0 becomes negative. The curve recrosses the zero line again at 80% and 99% nickel. On the addition of chromium to such alloys, similar curves

are obtained, but the maximum is less in value and is displaced towards a higher nickel content. W. G.

The Peculiar Chemical and Physical Properties of Ferrous Hydroxide Peroxide. Reduction of Alkali Nitrate. OSKAR BAUDISCH (*Ber.*, 1921, **54**, [*B*], 406—413). It has been shown previously that ferrous hydroxide in neutral or faintly alkaline solution is unable to effect the reduction of nitrate to nitrite and that this well known process is attributable to the co-operation of atmospheric oxygen. It is now demonstrated that nascent ferrous hydroxide is a much more powerful reducing agent towards nitrate than the freshly precipitated compound, and, further, that nitrate is smoothly converted into nitrite by reduced iron in the absence of air. The probable similarity of the two processes is expressed in the schemes :



The ferrous hydroxide can thus yield an energetic peroxide by absorption of oxygen, which, by virtue of its iron nucleus, possesses the power of activating the oxygen subsidiary valencies of other substances and forming unstable compounds with them.

Ferrous hydroxide peroxide can also function as an oxidising agent, as is shown by the conversion of alcohol to aldehyde and by its behaviour towards starch and sugar. It acts in this respect in the same manner as light energy alone or in the presence of traces of iron. Since also it can effect the reduction of alkali nitrate to ammonia, it appeared probable that both types of reaction could occur in one and the same solution; this is shown to be the case, since formaldoxime and traces of nitromethane are formed when a methyl alcoholic, aqueous nitrite solution is treated with ferrous sulphate and an excess of sodium hydrogen carbonate and shaken with air. The nitrite is reduced to hyponitrous acid, which reacts with the formaldehyde produced by the oxidation of methyl alcohol, yielding formhydroxamic acid, which is in part converted into formaldoxime.

It is remarkable that metallic iron and ferrous hydroxide peroxide are strongly magnetic, whereas ferrous hydroxide is not; it does not appear possible at present to bring these properties into line with the chemical behaviour. H. W.

Anhydrous Yellow Ferric Oxide. JOHN H. YOE (*J. Physical Chem.*, 1921, **25**, 196—200).—Anhydrous yellow ferric oxide was obtained in admixture with aluminium oxide, calcium sulphate, barium sulphate, aluminium oxide, and calcium sulphate, and aluminium oxide and barium sulphate. The results confirm and extend the observations of Scheetz (A., 1917, ii, 574). Attempts to

remove the stabilising agent, for example, by dissolving aluminium oxide in sodium hydroxide, invariably resulted in agglomeration of the ferric oxide, with change of colour to red. J. R. P.

Double Pyrophosphate of Iron and Sodium. E. OLIVERI-MANDALÀ (*Gazzetta*, 1921, **51**, i, 130—137).—This compound, which has the composition, $Fe_4(P_2O_7)_3,3Na_4P_2O_7,14H_2O$, and not $Fe_4(P_2O_7)_3,5Na_4P_2O_7,14H_2O$, as stated by Pahl (This Journal, 1874, 338, 774), may be prepared pure by saturating sodium pyrophosphate solution with moist ferric pyrophosphate with the aid of a mechanical stirrer, the dissolution of the calculated amount of sodium pyrophosphate in ferric chloride solution of D 1·28—1·282, followed by precipitation of the double salt by means of alcohol, giving a product containing sodium chloride; in presence of the latter, the solubility of the double pyrophosphate is lowered. Ferric pyrophosphate dissolves in sodium pyrophosphate solution always in the proportion $Fe_4(P_2O_7)_3 : 3Na_4P_2O_7$, independently of the concentrations. Ferric phosphate is soluble also in alkaline citrate solutions, yielding complex salts in which the reactions for iron are masked. T. H. P.

A Comparison of the Atomic Weights of Terrestrial and Meteoric Nickel. I. The Reduction of Nickelous Oxide. GREGORY PAUL BAXTER and LEON WOODMAN PARSONS (*J. Amer. Chem. Soc.*, 1921, **43**, 507—518).—To compare the atomic weights of terrestrial and meteoric nickel, the method by the reduction of nickelous oxide with hydrogen was chosen, as it would also serve to check the atomic weight determination made by Richards and Cushman (A., 1898, ii, 228) by analysis of the bromide. The nickelous oxide was in each case prepared by ignition of the nitrate, and since it is impossible to free the oxide from occluded gases at the temperature used, 1000°, it was necessary to make independent determinations of the occluded gases in each sample. The oxide generally contained about 0·11% of gases. As a result of nine determinations with terrestrial material, a mean atomic weight of 58·70 was found, whilst three experiments with meteoric nickel gave 58·68. The value found by Richards and Cushman was 58·68 (Ag = 107·88). The difference found between terrestrial and meteoric nickel is considered to be within the limits of experimental error, but further comparisons are to be made. E. H. R.

Solubility. II. Polyiodides of Ammines. FRITZ EPHRAIM and PAUL MOSIMANN (*Ber.*, 1921, **54**, [*B*], 385—396).—An account of experiments on which a part of the authors' theory (this vol., ii, 305) is based.

Nickelhexammine chloride or a solution of nickel chloride in ammonia, is transformed by relatively varying quantities of iodine dissolved in potassium iodide into a series of polyiodides of which members, corresponding approximately with the formulæ $[Ni(NH_3)_4]I_2,I_2$, $[Ni(NH_3)_4]I_2,2I_2$, $[Ni(NH_3)_4]I_2,4I_2$, and $[Ni(NH_3)_4]I_2,6I_2$ have been isolated. It does not appear probable, however, that these are well-defined individuals of a series of compounds, but rather that a continuous series of solid solutions is produced. A solution of zinc sulphate in concentrated ammonia is

only converted by a large excess of iodine into *zinctetrammine polyiodide*, $[Zn(NH_3)_4]I_2,2I_2$, dark violet leaflets. Similarly, cadmium sulphate gives the *compound* $[Cd(NH_3)_3H_2O]I_2,2I_2$. With a large excess of iodine, *coppertetrammine polyiodide*, $[Cu(NH_3)_4]I_2,4I_2$, is obtained as a blackish-brown, not distinctly crystalline precipitate; with smaller amounts of the halogen, polyiodides with a lower iodine content which have been described previously are produced. Cobalt appears to form a *polyiodide*, $[Co(NH_3)_4]I_2,2I_2$, but its isolation in a pure condition is extremely difficult by reason of the great oxidisability of ammoniacal cobalt solutions. Magnesium and calcium salts yield nitrogen iodide when treated with potassium polyiodide in ammoniacal solution, even in the presence of ammonium salts.

Cobalthexammine chloride gives a *polyiodide*, $[Co(NH_3)_6]I_3,2I_2$, bluish-black crystals, and, with a very large excess of iodine, a *compound*, $[Co(NH_3)_6]I_3,3I_2$, transparent, brown needles. A similar *polyiodide*, $[Cr(NH_3)_6]I_3,3I_2$ is obtainable from luteochromium compounds.

The freely soluble cis-*compound*, $[Co(NH_3)_4(NO_2)_2]I$, yellow octahedra, is prepared from the corresponding nitrate and an excess of potassium iodide in aqueous alcoholic solution; it yields two *polyiodides*, $[Co(NH_3)_4(NO_2)_2]I,I_2$, slender, green needles and $[Co(NH_3)_4(NO_2)_2]I,2I_2$, black crystals, the limit of additive capacity for iodine being probably attained in the latter compound. The similar trans-*compound*, $[Co(NH_3)_4(NO_2)_2]I$, forms yellow, distorted cubes, and yields a tri-iodide, reddish-brown precipitate, without distinct crystalline form, the relatively pale colour of which makes it doubtful if the product is a true polyiodide. *Cobalt-tetrammine-carbonatopolyiodide*, $[Co(NH_3)_4(CO_3)]I,I_2$, forms black, crystalline aggregates.

The stability of the various polyiodides has been investigated by repeated agitation of the solid substances with fixed amounts of carbon disulphide and estimation of the amount of iodine which has passed into solution after equilibrium has been established, the method being, when necessary, controlled by analysis of the residual solid. Among the penta-iodides of the ammines of bivalent metals, it is found that iodine is more firmly retained with increasing atomic volume of the metal. The nickel compounds readily lose the whole of the iodine, the compound $[Ni(NH_3)_4]I_2,I_2$ forming a well-marked intermediate stage. The cadmium compound retains iodine much more firmly, and this phenomenon is even more marked with the zinc salt. $[Co(NH_3)_4(CO_3)]I,I_2$ retains the polyiodide iodine very firmly, $[Co(NH_3)_4(NO_2)_2]I,I_2$ with medium tenacity. $[Co(NH_3)_6]I_3,3I_2$ readily parts with all its iodine. In general, the capacity to lose iodine completely is exhibited by those substances which have the power of becoming rich in iodine, but this behaviour may be merely accidental. H. W.

Solubility. III. Compounds Derived from Ammines and Bismuth or Mercury Iodides. FRITZ EPHRAIM and PAUL MOSIMANN (*Ber.*, 1921, **54**, [*B*], 396—401. Compare preceding abstract).—The following compounds were prepared by the

addition of bismuth or mercuric salts dissolved in an excess of potassium iodide solution to solutions of the requisite ammine. The bismuth compounds could be obtained only from ammines of tervalent cobalt. *Hexamminocobaltibismuth iodide*, $[Co(NH_3)_6]I_3,BiI_3$, small, dark-red, pointed crystals; *chloropentamminocobaltibismuth iodide*, $[Co(NH_3)_5Cl]I_2,2BiI_3$, red, microcrystalline powder; *dinitrotetramminocobaltibismuth iodide*, $[Co(NH_3)_4(NO_2)_2]I,BiI_3$ (flavo-salt, red, hexagonal rods, croceo-salt, microcrystalline powder); *carbonatotetramminocobaltibismuth iodide*, $[Co(NH_3)_4(CO_3)]I,BiI_3$, reddish-yellow granules. The following nickel–ammine mercury *iodides* are described: $[Ni(NH_3)_4]I_2,HgI_2,4H_2O$, $[Ni(NH_3)_6]I_2,HgI_2,8H_2O$, $[Ni(NH_3)_4]I_2,2HgI_2,2H_2O$, $[Ni(NH_3)_6]I_2,2HgI_2,8H_2O$. The first and second of these are obtained with an excess of nickel salt, the third and fourth when the mercuric salt predominates; the tetrammines are prepared in feebly, the hexammines in more strongly, ammoniacal solution. The former are greenish-blue, the latter pale violet. Zinc salts yield only the *compound*, $[Zn(NH_3)_4]HgI_4$, colourless or pale yellow octahedra or cubes; the cadmium *compounds*, $[Cd(NH_3)_4]HgI_4,4H_2O$ and $[Cd(NH_3)_6]HgI_4,6H_2O$, are formed in less or more strongly ammoniacal solution respectively. Under similar conditions, a very unstable silver salt appears to be formed. Cobalt gives only a very basic compound, whilst magnesism and manganese salts do not give precipitates with potassium mercuric iodide.

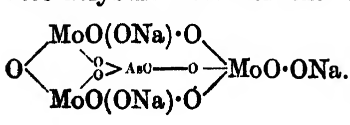
Carbonatotetramminocobaltimercury iodide,

$$\{[Co(NH_3)_4(CO_3)]I\}_2,HgI_2,$$

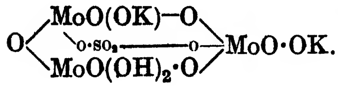
crystallises in red rhombs. The flavo-salt of *dinitrotetramminocobaltimercury iodide*, $[Co(NH_3)_4(NO_2)_2]I_2,HgI_2$, forms brown needles, whereas the *croceo*-salt crystallises in yellow octahedra. *Hexamminocobaltimercury iodide*, $[Co(NH_3)_6]I_3,HgI_2$ is a reddish-brown, shining powder.

Hexamminocobaltiferrocyanide, $[Co(NH_3)_6]_4[Fe(CN)_6]_3$, is prepared from potassium ferrocyanide and luteocobalt chloride; with the purpureo-chloride, the two dinitrotetramminocobalti- and the carbonatotetramminocobalti-compounds, potassium ferrocyanide gives colloidally turbid solutions which gradually deposit precipitates owing to decomposition. Potassium ferricyanide does not give precipitates with the cobaltammines mentioned above with the exception of the luteo-salt. H. W.

System and Constitution of Complex Derivatives of the Molybdic Acids. L. FORSÉN (*Compt. rend.*, 1921, **172**, 681—684. Compare this vol., ii, 205).—The complex acids may be grouped in three general series, namely, (1) complex orthomolybdic acids of the type $H_3(AsOMo_3O_{12})$, (2) complex metamolybdic acids of the type $H_3(AsOMo_{12}O_{42}H_6)$ or $H_4(SiOMo_{12}O_{42}H_6)$, (3) complex luteomolybdic acids of the type $AsO(Mo_3O_{12}H_5)H_3$. Arsenio-*o*-molybdic acid is tribasic and its sodium salt is assigned the annexed constitution. Phospho-*o*-molybdic acid is not known, but some of its salts are. Sulphato-*o*-molybdic acid



is not known, but the author has prepared a new *potassium* salt, $K_2H_2(SO_2Mo_3O_{12}),3H_2O$, which rapidly loses $4H_2O$ and on heating gives anhydrous potassium trimolybdate. It probably has the annexed constitution. Too few salts of the complex metamolybdic acids are known for their constitution to be discussed. The free luteo-acids are very stable and tribasic, and to them is assigned the constitution of the type



$$AsO\left[O\cdot MoO(ONa)<\begin{matrix}O\cdot MoO(OH)_2\\ O\cdot MoO(OH)_2\end{matrix}>O\right]H_3.$$

W. G.

A System for the Molybdates. S. Posternak (*Compt. rend.*, 1921, **172**, 597—599).—The author does not consider that the system recently proposed by Forsén (this vol., ii, 205, 265) complies with the experimental facts which he has published (A., 1920, ii, 374; this vol., ii, 51, 117, 118). W. G.

Volume Changes of Tin Amalgams. Carola Köller (*Zeitsch. Metallkunde*, 1921, **13**, 1—19).—The volume changes of tin amalgams having the compositions HgSn, $HgSn_2$, $HgSn_3$, and $HgSn_4$ were investigated by the dilatometer method. With increasing temperature the coefficient of expansion first falls or remains practically constant over a considerable range, then rises rapidly to a maximum corresponding practically with the melting point of the amalgam. This abnormal behaviour is due to volume changes similar in character to those occurring in the case of bismuth amalgam and some other alloys. When the tin amalgam is alternately heated and cooled, the final volume is always less than the initial volume. Contraction also occurs when the freshly-prepared alloy is maintained at a steady temperature for some time, the rate of contraction depending on the previous treatment to which the specimen has been subjected. The nature of the structural changes responsible for this behaviour has not been elucidated.

E. H. R.

Preparation of Zirconia from Brazilian Ore and a New Method of Estimation. E. C. Rossiter and P. H. Sanders (*J. Soc. Chem. Ind.*, 1921, **40**, 70—71T).—Fifty grams of the powdered ore are fused in an iron crucible with 50 grams of sodium hydroxide; the mixture is stirred until frothing ceases, and a granular powder is obtained, the heating being then continued at dull redness for two hours. The mass, while hot, is poured into 1·5 litres of water, the solution filtered, the insoluble residue treated with hydrochloric acid, and evaporated to dryness. The dry residue is extracted with hot water and the solution filtered. This solution is diluted to 1·5 litres, boiled after the addition of a slight excess of sulphurous acid, and $N/1$ sulphuric acid is added gradually until the mixture becomes quite thick. After a short time the whole of the zirconia is precipitated as basic sulphate; the precipitate is collected, washed, dried, and ignited to form the oxide, or the precipitate may be suspended in water, treated with alkali,

and the hydroxide collected, dried, and ignited. A modification of the process may be used for the estimation of small quantities of zirconia in the presence of iron, etc. The solution, containing about 0·2 gram of ZrO_2, is diluted to 150 c.c., boiled with the addition of sulphurous acid (to reduce ferric salts), neutralised with ammonia, and again boiled after the addition of 10 c.c. of sulphurous acid and 2 c.c. of $N/1$ sulphuric acid. The precipitated basic sulphate is collected, dissolved in hydrochloric acid, the solution evaporated to dryness, the residue dissolved in water, and the zirconia reprecipitated as described, ignited, and weighed. W. P. S.

The Electromotive Behaviour of some Binary Alloys. XVII. Antimony–Selenium Alloys and their Metallographic Investigation. ROBERT KREMANN and ROBERT WITTEK (*Zeitsch. Metallkunde*, 1921, **13**, 90—97).—The *E.M.F.* of antimony–selenium alloys were measured against a reference electrode of antimony, using a hydrochloric acid solution of antimony trichloride as electrolyte. The experiments were conducted in darkness or in diffused daylight on account of the sensitiveness to light of the selenium alloys. The *E.M.F.*-composition curve departs considerably from the ideal stepped form, but indicates clearly the potentials of the compounds SeSb and Se_3Sb_2. This divergence from the ideal form of curve is probably due to the formation of surface layers of lower potential, causing a too early drop in *E.M.F.* The microscopic appearance of the alloys confirms the existence of the above two compounds. E. H. R.

The Electromotive Behaviour of some Binary Alloys. XVI. Alloys of Bismuth with Sodium and Potassium. ROBERT KREMANN, JULIUS FRITSCH, and RICHARD LIEBL (*Zeitsch. Metallkunde*, 1921, **13**, 66—73).—The potential of sodium–bismuth alloys was measured against a bismuth electrode in a pyridine solution of sodium iodide, or in aqueous sodium sulphate in the case of the alloys poor in sodium. Concordant results could not be obtained owing to the formation of surface layers, but in general, with from 10 to 80 atom. % of bismuth, the *E.M.F.* was constant at about 1·6 to 1·7 volts, about 0·4 to 0·5 volt below the sodium potential. For measuring the potential of potassium–bismuth alloys against bismuth, a pyridine solution of potassium chloride was used. With these alloys there was little tendency for surface layers of lower potential to form, and the *E.M.F.* curve showed two sharp steps corresponding with K_3Bi at 1·60 volts and KBi_2 at about 0·80 volt. E. H. R.

Gold Sols. ERICH VON KNAFFL-LENZ (*Kolloid Zeitsch.*, 1921, **28**, 149—153).—A number of gold sols prepared by different methods have been examined with the object of ascertaining whether the reducing agent employed influences the properties of the sol to a marked extent and also to ascertain whether gold sols are to be regarded as complexes of a gold compound with the oxidation product formed in the reduction process or no. The sols examined were prepared from a dilute aqueous solution of chloroauric acid which was reduced in the presence of potassium carbonate at the

boiling point by acetaldehyde, trichloroacetaldehyde, benzaldehyde, cinnamaldehyde, terephthalaldehyde, and arsenic hydride, respectively. The sols thus produced were examined in respect of their specific conductivity, stability, colour, and the action of hydrochloric acid, potassium chloride, barium chloride, and albumin toward them. The results show that whilst there are minor differences to be found between the behaviour of the various sols, these are such as to be attributable to slight differences in the concentration of the chloroauric acid from which the sols were made, and are entirely insufficient to furnish any confirmation of the hypothesis of complex compound formation. Tests made with the sols produced by reduction with arsenic hydride show that a very small quantity of arsenic is retained by the dialysed sol, but the amount of arsenic present divides itself between the gel and the filtrate when the sol is coagulated. The sols from terephthalaldehyde, when treated with arsenic hydride, behave in exactly the same way. J. F. S.

Mineralogical Chemistry.

Some Constituents of Lignites. R. CIUSA and A. GALIZZI (*Gazzetta*, 1921, **51**, i, 55—60).—The xyloid lignite of Fognano, near Montepulciano, contains a white, crystalline incrustation which, after purification, has the formula $C_{15}H_{20}$, m. p. 61—62°, b. p. 314—316° or 208—210°/23 mm., and constitutes a new mineral species, for which the name *simonellite* is suggested. It forms brittle, rhombic plates [G. BOERIS—$a:b:c = 0{\cdot}9908:1:1{\cdot}9694$], does not decolorise bromine or permanganate solution, but is oxidised by alkaline permanganate or by chromic acid, yielding a red substance with the appearance and behaviour of a quinone. Besides simonellite, the Fognano lignite yields a liquid which, on fractionation, gives three dense, colourless, odourless liquids behaving as unsaturated hydrocarbons and having the properties and compositions: (1) $C_{15}H_{28}$, b. p. 222—228/25 mm.; (2) $C_{15}H_{28}$, b. p. 240—244°/25 mm., and (3) $C_{15}H_{26}$, b. p. 253°/25 mm.

A lignite deposit near Terni contains the hydrocarbon $C_{20}H_{34}$, which forms feathery masses of crystalline plates, m. p. 74—75°, and is possibly identical with the natural hydrocarbon, hartite.

The material known commercially as Forli lignite has more the character of peat and is found to contain lignoceric acid.

T. H. P.

Minerals of Lazio. Melilite of Inclusions in Peperino. F. MILLOSEVICH (*Atti R. Accad. Lincei*, 1921, [v], **30**, i, 80—84).—The peperino used for the foundations of the Villa Volterra at Albano (Latium) was found to contain clear, bright crystals of melilite having the composition:

SiO_2.	Al_2O_3.	Fe_2O_3.	CaO.	MgO.	Na_2O.	K_2O.	Total.
41·07	10·47	3·80	33·92	6·02	3·25	1·04	99·57

and the constants, D^{15} 2·929, $a : c = 1 : 0·45643$. If, as Schaller considers (A., 1916, ii, 632), melilites consist of isomorphous mixtures of sarcolite, a hypothetical soda-sarcolite, velardeñite, and åkermanite, the sample now described contains 27·5, 9·0, 15·0, and 48·5% respectively of these components. T. H. P.

Analytical Chemistry.

Spot Reactions in Qualitative Analysis. E. HAUSER (*Zeitsch. anal. Chem.*, 1921, **60**, 88—91).—The author agrees with Feigl and Stern (this vol., ii, 278) as to the usefulness of spot reactions in qualitative analysis. W. P. S.

Physico-chemical Volumetric Analysis. R. DUBRISAY (*Ann. Falsif.*, 1921, **14**, 9—18).—The advantages of physico-chemical methods of titrations are dealt with, particular attention being directed to electro-chemical, cryoscopic, and surface tension methods (compare A., 1913, ii, 586). W. P. S.

A Process of Spectrum Analysis by Means of Röntgen Rays. MANNE SIEGBAHN, AXEL E. LINDH, and NILS STENSSON (*Zeitsch. Physik*, 1921, **4**, 61—67).—A vacuum spectrograph is described by means of which the X-ray spectrum may be used for spectrum analysis of mixtures in the ordinary course of analysis. The instrument is built with a wide opening angle, about 40°, and with a fixed calcspar or gypsum crystal so that with two exposures, each approximately two hours in duration, it is possible to obtain a photograph of the lines corresponding with all the elements from sodium to uranium. This method is to be recommended because of the relative simplicity of the spectra. The identification of the lines is simplified by the use of keys prepared for each crystal used in the instrument. J. F. S.

The Importance of Adsorption in Analytical Chemistry. VIII. The Adsorption of Asbestos. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 401—407).—Ordinary commercial asbestos, even that specially prepared for analytical purposes, cannot safely be used without having first been repeatedly extracted with acid. No adsorption will occur if the asbestos has been so treated until it no longer takes up acid from the solution.

Impure asbestos adsorbs positive ions from solutions in accordance with the adsorption law, $x=\alpha c^{1/n}$, where x is the amount adsorbed in milli-moles per gram of asbestos, c is the end concentration, and α and $1/n$ are constants. The constant $1/n$ has the same value for kations of the same valency, and appears to vary inversely with the valency for uni- and bi-valent kations. On account of the ease with which lead is adsorbed from dilute

solutions by such impure asbestos, being afterwards readily dissolved out again by means of acids, the estimation of this metal in drinking water may conveniently be carried out with asbestos.

S. I. L.

Apparatus for Sodium Peroxide Fusions. H. J. HODSMAN (*J. Soc. Chem. Ind.*, 1921, **40**, 74T.).—The mixture of sodium peroxide and substance to be oxidised is placed in a thin-walled steel cylinder which is closed at the bottom and provided with a closely-fitting cap; this cylinder is placed in an outer cylinder, the lid of which is held in place by a bayonet catch, which, when drawn up, holds the cap of the inner cylinder in place. The apparatus is clamped in an inclined position, and the base is heated with a burner until firing has occurred. W. P. S.

Analysis of Fluorides. EDUARDO D. GARCÍA (*Anal. Soc. Quím. Argentina*, 1920, **8**, 235—241).—A review of earlier methods is given. In Doyle's method (A., 1919, ii, 349) an error is caused by the loss of fluorine as aluminium fluoride. In the method proposed, calcium is determined in the residue from the treatment with acetic acid (as in Doyle's method) after removal of silica, iron, and aluminium. The amount of calcium fluoride is calculated on the assumption that all the calcium in the residue is present as such.

G. W. R.

Estimation of Nitrous Fumes in Air, with Special Reference to Fuse-igniters. JAMES MOIR (*J. S. African Assoc. Anal. Chem.*, 1921, **4**, 3—7).—A definite quantity of nitrite solution is heated at 50° with 10 c.c. of *p*-nitroaniline solution (*p*-nitroaniline 1·5 grams, concentrated hydrochloric acid 40 c.c., and water to 500 c.c.), 10 c.c. of α-naphthol solution (α-naphthol 2 grams, sodium hydroxide 1·1 grams, sodium acetate 10 grams, and water to 500 c.c.) are then added and, after one hour, the orange-red precipitate is collected and weighed; 92 parts of NO_2, or 69 parts of sodium nitrite, yield 292 parts of precipitate. To estimate NO_2 apart from nitrite in the fumes produced by fuse-igniters, the gas is left in contact with neutral hydrogen peroxide solution for twenty-four hours, and the acidity then titrated with sodium hydroxide solution, using methyl-orange as indicator; each c.c. of $N/10$-alkali solution is equivalent to 0·0060 gram of NO_2. An alternative method consists in agitating the fumes for six hours with 5% potassium iodide solution and then titrating the liberated iodine with thiosulphate solution; each c.c. of $N/10$-solution is equivalent to 0·0051 gram of NO_2. This method can be applied only in neutral solution.

W. P. S.

Comparative Results with Scales's [Zinc–Copper Couple] and Devarda's Alloy for Reducing Nitric Nitrogen. A. P. HARRISON (*J. Biol. Chem.*, 1921, **46**, 53—56).—Scales's zinc–copper couple (A., 1917, ii, 41) gives as accurate results as Devarda's alloy, and has the advantage of not requiring to be weighed. Two hundred c.c. of the solution with 0·1 mg. *N* per c.c. is poured into a flask containing 80 grams of freshly prepared zinc–copper couple,

about 5 grams of sodium chloride and 1 gram of magnesium oxide are added, and 150 c.c. distilled into a flask containing 50 c.c. of 4% boric acid. It is titrated with bromophenol-blue as indicator.

G. B.

The Diphenylamine Reaction. ALBERT B. WEINHAGEN (*J. Amer. Chem. Soc.*, 1921, **43**, 685).—The statements of Harvey (A., 1920, ii, 504) in regard to the influence of varying proportions of water are confirmed. Satisfactory results have been obtained by stirring the substance under examination with ten drops of a solution of diphenylamine in sulphuric acid by the aid of a glass rod moistened with water. Successive additions of water in this manner involve little risk of missing the most favourable concentration for the reaction.

J. K.

Iron as the Cause of a Formaldehyde and Diphenylamine Reaction of Milk. F. REISS (*Zeitsch. Nahr.-Genussm.*, 1921, **41**, 26—29).—Traces of iron in milk cause the latter to give reactions with formaldehyde and with diphenylamine–sulphuric acid reagent and thus erroneously indicate the presence of nitrates. The iron may be derived from the vessels (rusty cans) in which the milk is kept.

W. P. S.

Decomposition of Nitrous Acid. E. OLIVERI-MANDALÀ (*Gazzetta*, 1921, **51**, i, 138—140).—The action of hydrazoic acid on nitrous acid proceeds quantitatively in accordance with the equation $HNO_2 + HN_3 = H_2O + N_2O + N_2$, the unstable suboxide, N_4O, being probably formed as an intermediate product; no trace of nitric acid is formed.

This reaction may be employed for the detection of nitric acid in presence of nitrous acid, other methods for such detection yielding uncertain results owing to the formation of appreciable traces of nitric acid by partial decomposition of the nitrous acid. The test is carried out as follows: To the solution containing nitric and nitrous acids, acidified with acetic acid when the nitrous acid is present as salt, are added either a few c.c. of dilute hydrazoic acid solution or a little of its sodium salt. The liquid is then boiled to expel, as far as possible, excess of hydrazoic acid, which masks all the colour reactions employed to identify nitrates and nitrites. After the heating, a portion of the liquid is tested with an acetic acid solution of naphthylamine and sulphanilic acid to ascertain if all the nitrous acid has been destroyed, the remainder being examined for nitric acid.

T. H. P.

Estimation of Phosphorus in Copper Phosphide. EDUARDO D. GARCÍA (*Anal. Soc. Quím. Argentina*, 1920, **8**, 104—105).—Solution is effected by means of hydrochloric acid and potassium chlorate. Group II metals are removed by means of hydrogen sulphide. The filtrate is concentrated and boiled with a little nitric acid, aluminium sulphate is added, and by addition of ammonia all the phosphorus is precipitated as aluminium phosphate. This is dissolved in nitric acid and the phosphorus estimated by the ordinary phosphomolybdate method.

G. W. R.

Estimation of Phosphorus in Steels. Separation of the Phosphorus from the other Components of the Steel. R. Ariano (*Gazzetta*, 1921, **51**, i, 1—31).—The theoretical considerations involved in the estimation of phosphorus in steel are discussed, as well as (1) the methods used for the separation of the silicon, copper, arsenic, etc., and (2) the precipitation of the phosphorus by the acetate method and by the phosphomolybdate method [see *J. Soc. Chem. Ind.*, 1921, May]. T. H. P.

The Technique of the Estimation of Phosphoric Acid. The Application of Pregl's Method in Serum Analysis. Stella Wiener (*Biochem. Zeitsch.*, 1921, **115**, 42—45).—The protein of the serum is removed with a mixture of picric and acetic acids and the phosphorus estimated by Pregl's method. The "lipoid" phosphorus is estimated in the precipitated residue after it has been incinerated. It can also be estimated by difference by subtracting the phosphorus content as estimated after precipitation of the protein from the total phosphorus estimated by incinerating the whole serum. S. S. Z.

Volumetric Estimation of Arsenious Compounds by Means of Potassium Dichromate. R. Meurice (*Ann. Chim. Anal.*, 1921, **3**, 85—86).—Hydrochloric acid and potassium bromide are added to the arsenious acid solution and the mixture is titrated with standardised dichromate solution; during the titration, a current of air is bubbled through the mixture and then through potassium iodide–starch solution contained in a test-tube. When all the arsenious acid has been oxidised, the next drop of dichromate solution added liberates bromine, which is carried over into the potassium iodide and a blue coloration develops in the latter.
W. P. S.

The Separation and Detection of Arsenate and Arsenite. George W. Sears (*J. Amer. Chem. Soc.*, 1921, **43**, 466—470).—Determinations of the solubility of silver arsenate and silver arsenite respectively in sodium hydroxide solution show that, whereas the former is readily dissolved in the cold by 0·5 to 1·5*N*-sodium hydroxide, the latter is practically insoluble. The arsenate dissolves according to the equation $2Ag_3AsO_4 + 2NaOH + H_2O = 2NaH_2AsO_4 + 3Ag_2O$. Higher concentrations of sodium hydroxide react slowly with silver arsenite with formation of arsenate and precipitation of metallic silver. To separate arsenate and arsenite, their nitric acid solution containing excess of silver nitrite is neutralised with sodium hydroxide until the silver oxide precipitate just fails to redissolve. The washed precipitate is then shaken with about 25 c.c. of a solution containing about 3 c.c. of 6*N*-sodium hydroxide solution. This is sufficient to dissolve at least 0·45 gram of silver arsenate. The arsenate and arsenite can be detected in the filtrate and residue respectively by the usual methods.
E. H. R.

Rapid Dry Combustion Method for the Simultaneous Determination of Soil Organic Matter and Organic Carbon. J. W. Read (*J. Ind. Eng. Chem.*, 1921, **13**, 305—307).—By means of Levene and Bieber's rapid combustion method (A., 1918, ii, 130), and with the aid of a combustion boat with a perforated base and a special filter funnel, the organic matter and the organic carbon may be estimated simultaneously. T. H. P.

Estimation of Carbon Dioxide in Air. Julius Freund (*Zeitsch. Hyg.*, 1920, **91**, 218—222; from *Chem. Zentr.*, 1921, ii, 385—386).—Two simplified modifications of the Pettenkoffer method are described. In the first, a weak solution of sodium hydroxide is mixed with barium chloride solution in the flask, shaken with air, and a portion of the filtrate titrated with phenolphthalein as indicator.

The second method, which gives results in agreement with the Pettenkoffer method, is carried out as follows: 180 or 190 c.c. of distilled water, 5 c.c. of phenolphthalein and 20 to 10 c.c. of $N/10$-sodium hydroxide are placed in the flask filled with the air under examination. The stoppered flask is then shaken for twenty minutes and two portions of 50 c.c. are titrated with phenolphthalein as indicator. The difference between the titre thus obtained and a blank titration when multiplied by $4 \times 2{\cdot}24$ gives the carbon dioxide in c.c. at N.T.P. G. W. R.

The Estimation of Silicon in Cast Iron. Eduardo D. García (*Anal. Soc. Quím. Argentina*, 1920, **8**, 40—52).—A review of the various methods used for the estimation of silicon in cast iron. G. W. R.

Estimation of the Alkalinity and of Phosphates in the Ashes of Foods. J. Tillmans and Anna Bohrmann (*Zeitsch. Nahr.-Genussm.*, 1921, **41**, 1—17).—The alkalinity is estimated by boiling a portion of the ash with an excess of standardised acid, then adding 30 c.c. of 40% calcium chloride solution, and titrating the excess of acid, using phenolphthalein as indicator. Another portion (at least 0·2 gram) of the ash is boiled for one hour with 100 c.c. of $N/10$-hydrochloric acid, cooled, and titrated with $N/10$-sodium hydroxide solution, using methyl-orange as indicator (c.c. of $N/10$-acid used equal B); 20 c.c. of saturated sodium oxalate solution are now added and the titration is continued, using phenolphthalein as indicator (c.c. of alkali used equal C). Then, if A is the number of c.c. of $N/10$-acid required to neutralise the alkalinity of the ash, the amount of orthophosphate, Y (mg. of PO_4), in the weight of ash taken is $3/2(B - A) \times 3{\cdot}167$; if the ash is not alkaline and C is a positive value, the orthophosphate is found by the formula $Y = 3C \times 3{\cdot}167$, and the pyrophosphate, Z, equals $2(B - 2C) \times 4{\cdot}75$. When C has a negative value, pyro- and meta-phosphates are present; in this case, Z equals $2B \times 4{\cdot}75$, and the metaphosphate, U, equals $- C \times 9{\cdot}5$. W. P. S.

Centrifugal Method for Estimating Potassium. Elmer Sherrill (*J. Ind. Eng. Chem.*, 1921, **13**, 227—228).—Five c.c. of a solution of the potassium salt (containing about 1% of K_2O)

are mixed in a centrifugal tube with 17 c.c. of sodium cobaltinitrite solution; a similar mixture is made in another tube, using in this case a solution containing a known amount of potassium. Both tubes are submitted to centrifugal action; the volumes of the precipitates are noted and a simple calculation gives the amount of potassium in the test solution. W. P. S.

The Przibylla Tartrate Method for Potassium. E. Borsche (*Kali*, 1920, **14**, 275—280, 303—308, 358—361, and 374—382; from *Chem. Zentr.*, 1921, ii, 476).—It is shown that the precipitation of potassium by tartaric acid, filtration, and titration of the excess of tartaric acid in the filtrate, is employable as a works method, provided that the accompanying material is not too variable in composition. Tables are usually given for salts of 80% or higher grades. For fertiliser salts of 20 to 40% grade special tables must be made to allow for deviations caused by the differing content of the other salts present. G. W. R.

New Method for the Estimation of Potassium in Silicates. Jerome J. Morgan (*J. Ind. Eng. Chem.*, 1921, **13**, 225—226).—The silicate is decomposed by treating it with hydrofluoric acid at the ordinary temperature; a small quantity of dilute hydrochloric acid is then added and the mixture evaporated with the addition of perchloric acid; the residue is dissolved in water, and the evaporation repeated with the addition of a further quantity of perchloric acid. The potassium perchlorate formed is collected, washed, dried, and weighed in the usual way. Sodium and calcium sulphates interfere, since these are insoluble in alcohol containing perchloric acid, and their presence necessitates an estimation of sulphate in the weighed potassium perchlorate precipitate.
W. P. S.

Soil Reaction. II. The Colorimetric Determination of the Hydrogen-ion Concentration in Soils and Aqueous Soil Extracts. E. A. Fisher (*J. Agric. Sci.*, 1921, **11**, 45—65. Compare this vol., i, 215).—Details are given of the colorimetric method of determining hydrogen-ion concentration in a comparator as applied to soil extracts, the preparation of the requisite standard buffer solutions and the indicator solutions being given. For the determination of lime-requirements, increasing amounts of barium hydroxide are added to the soil before making the extract, the hydrogen-ion concentration is determined in each case, and a curve plotted. By interpolating at $-\log[H^{\cdot}] = 7{\cdot}07$ and calculating barium hydroxide into calcium oxide, the lime requirement is obtained. It is shown that fineness of division of the soil is an important factor in these soil acidity determinations. W. G.

Estimation of Calcium and Magnesium in Different Saline Solutions. E. Canals (*Bull. Soc. Chim.*, 1921, [iv], **29**, 152—158. Compare A., 1920, ii, 193, 708).—Magnesium is not precipitated along with the calcium oxalate if the dilution of the magnesium ion is greater than 1‰. If owing to higher concentrations some

of the magnesium is precipitated, it may be removed by repeated washing with boiling water, 500 c.c. being necessary in some cases.

W. G.

[**Estimation of Thallium as Chromate.**] V. CUTTICA and G. CANNERI (*Gazzetta*, 1921, **51**, i, 169—174).—See this vol., i, 322.

Electro-analytical Separation of Copper, Antimony, and Tin. F. FOERSTER and D. AANENSEN (*Zeitsch. Elecktrochem.*, 1921, **27**, 10—16).—The method of electro-analysis of copper–tin alloys, containing about 5—10% of antimony, put forward by Schurmann and Arnold (A. 1908, ii, 898) has been examined and found to be thoroughly trustworthy. The authors describe a method of separation of these elements, with full working details. The solution is made by dissolving 0·04—0·05 gram of antimony in a little nitric acid and tartaric acid, 50 c.c. of a solution of copper nitrate are added, and the whole is evaporated to dryness. Five c.c. of nitric acid (D 1·4), 5 c.c. of 50% tartaric acid, 10 c.c. of stannous sulphate solution, and sufficient hydrogen peroxide to oxidise the latter, are added and the whole is made up to 40 c.c. This solution is electrolysed, with strong cooling, for an hour with a current of 1·5 amperes in a Frary apparatus with a 5-ampere coil current. The copper deposit is carefully removed from the cathode with nitric acid and tartaric acids and the copper redeposited in the same manner. Since the first deposit contains no tin but only antimony as impurity, the two solutions, after the second deposition of copper, are not mixed; but each is neutralised with sodium hydroxide, treated with 50 c.c. of 10% oxalic acid and also treated hot with hydrogen sulphide. The two antimony precipitates are united, dissolved in alkali sulphide, and the solution is treated as follows. To the solution, 30 c.c. of 30% potassium cyanide solution are added and the mixture is electrolysed at 70° with 0·6 ampère, using a Winkler net electrode. The deposition requires about two hours for 0·1 gram of antimony and the deposit is 1·8% heavier than the quantity of antimony present. The solution containing the tin is concentrated, neutralised with 50% potassium hydroxide, made alkaline with 2 c.c. of 50% potassium hydroxide solution, treated with 1 c.c. of 3% hydrogen peroxide, and boiled and diluted to 150 c.c. The tin is then deposited in three and a half hours at 80—85° on a Winkler electrode with a current of 5 ampères; during the electrolysis, 3 c.c. of 50% potassium hydroxide is added along with water to make good the evaporation. The method gives remarkably good results.

J. F. S.

Detection of Mercury as Cuprous Mercuric Iodide. P. ARTMANN (*Zeitsch. anal. Chem.*, 1921, **60**, 81—88).—When a drop of a mercury salt solution is placed on a strip of filter-paper which has been coated with cuprous iodide and dried, a bright red coloration is obtained; the test may also be carried out on a microscopic slide. The reaction may be obtained with a solution containing 2 mg. of mercury per litre. Bismuth salts, and substances which are reduced readily, must not be present, and the acidity of the mercury solution should not be greater than *N*/10.

W. P. S.

Electrolytic Separation of Mercury and Copper. W. Böttger (*Zeitsch. angew. Chem.*, 1921, **34**, 120—122).—For the removal of mercury and copper from a solution containing chlorine ions, 80 c.c. of the solution with 4 c.c. of nitric acid (D 1·4) and 3 c.c. of alcohol are electrolysed at an initial voltage of 2·2 volts, with a current of 3 amperes which drops to 1·5 amperes in three to five minutes. After separation of the mercury, the voltage is increased to 2·4 volts, the current increasing to 2·6 amperes, and copper is then separated in ten to fifteen minutes. After weighing the deposit, it is dissolved in nitric acid (D 1·2), diluted with an equal quantity of water, neutralised with ammonia, and, after addition of acid and alcohol, electrolysed at 1·4 volts. In Goecke's method, using potassium cyanide, the addition of concentrated ammonia before adding potassium cyanide prevents decomposition of the latter during electrolysis. A voltage of 2·9 volts, rising to 3 volts, is employed, and satisfactory results are obtained in twenty minutes. Separation of copper from 100 c.c. of a solution containing 5 c.c. of ammonia and 5 grams of potassium cyanide is effected at normal temperature with 3·2 volts, whilst without ammonia the necessary voltage is 3·8—4·5 volts. At 65°, an appreciably lower voltage, approximately 2 volts, may be employed.

W. J. W.

Principles of Analysis by Means of Reducing Flames; Detection of Traces of Manganese in the Presence of Iron or other Substances. Jean Meunier (*Compt. rend.*, 1921, **172**, 678—681).—When an oxide or a salt, introduced into a flame, undergoes a reduction there, that reaction is manifested by a line spectrum. If the oxide is not reduced, the spectrum of the metal is not produced, but only a continuous spectrum of incandescence. It is necessary in many cases to use a hydrogen flame, as its reducing action is more energetic than that of a gas flame. In this method manganese is characterised by the triplet, 4034·7, 4033·2, 4030·9, which is of extraordinary sensitiveness.

W. G.

Estimation of Small Quantities of Iron in Organic Liquids, Especially in Wines. P. Malvezin and Ch. Rivilland (*Ann. Chim. anal.*, 1921, **3**, 90—92; *Bull. Soc. chim.*, 1921, [iv], **29**, 237—239).—The method depends on the titration of ferric salts with thiosulphate solution, sodium salicylate being used as indicator and copper sulphate as catalyst in the reduction. For example, the ash from 20 c.c. of wine is dissolved in 10 c.c. of 5% hydrochloric acid, the solution filtered, and treated with 0·5 c.c. of hydrogen peroxide; after fifteen minutes, the mixture is boiled to decompose excess of hydrogen peroxide, 5 c.c. of 1% copper sulphate solution and 1 c.c. of 2% sodium salicylate solution are added, and the mixture is titrated with standardised thiosulphate solution, the end point being denoted by the disappearance of the violet coloration.

W. P. S.

Method of Separating Ferric, Aluminium, and Chromium Hydroxides. (Mme) M. Lemarchands and M. Lemarchands (*Ann. Chim. anal.*, 1921, **3**, 86—87).—The mixed precipitated

hydroxides are washed until free from ammonia and then boiled with 10% sodium hydroxide solution containing sodium perborate. The ferric hydroxide remains insoluble and is separated by filtration, whilst aluminium and chromium are found in the filtrate as sodium aluminate and sodium chromate. The aluminium may be separated by boiling a portion of the filtrate with an excess of ammonium chloride, and in another portion of the filtrate the chromium may be precipitated as lead chromate. W. P. S.

A New Method for the Detection and Estimation of Cobalt. S. A. Braley and F. B. Hobart (*J. Amer. Chem. Soc.*, 1921, **43**, 482—484).—It was noticed when testing for nickel with dimethylglyoxime that, when cobalt was present, a brown coloration resulted. This coloration has been found to be characteristic for cobalt, since, unlike the colour given by other metals, it is not discharged by mineral acids. It provides a sensitive test for cobalt in the absence of copper and iron. Since the depth of colour is proportional to the concentration, it can be used as a colorimetric method for the estimation of cobalt. For this purpose the cobalt dimethylglyoxime solution must be acidified with acetic acid and sodium acetate. E. H. R.

Cyanometric Assay of Nickel. G. H. Stanley (*J. S. African Assoc. Anal. Chem.*, 1921, **4**, 10—12).—The ammoniacal solution of the nickel salt is titrated with potassium cyanide solution, the end-point being denoted by the disappearance of the precipitate first formed. The end-point may be rendered sharper by adding a known amount of silver nitrate and a small quantity of potassium iodide, an allowance being made for the amount of added silver. If iron is present, the nearly neutral solution must be treated with an excess of cyanide, then rendered ammoniacal, filtered, the excess of cyanide titrated with silver nitrate solution in an aliquot portion of the filtrate, and the nickel estimated by difference. Copper must be removed previously, zinc may be removed by using sodium carbonate in place of ammonia for precipitating the iron, and cobalt is estimated together with the nickel; manganese does not interfere if ammonium chloride is added. Molybdenum tends to interfere if the titration is delayed. W. P. S.

Iodometric Method for the Estimation of Chromium in Chromite. Ernest Little and Joseph Costa (*J. Ind. Eng. Chem.*, 1921, **13**, 228—230).—A quantity of 0·4 gram of the chromite is fused in an iron crucible with 5 grams of sodium peroxide, the mass then dissolved in water, the solution treated with a further 0·5 gram of peroxide, and boiled to decompose the excess of the latter. The solution is then cooled, hydrochloric acid added until all ferric hydroxide has dissolved, 5 c.c. of concentrated hydrochloric acid per 100 c.c. of solution are introduced, followed by an excess of ammonium fluoride, and, after the addition of potassium iodide, the liberated iodine is titrated with standardised thiosulphate solution. W. P. S.

The Carrying Down of Lime and Magnesia by Precipitates of Chromic Oxide. ER. TOPORESCU (*Compt. rend.*, 1921, **172**, 600—602).—In the precipitation of chromium from solutions of its salts by ammonium hydroxide, when calcium or magnesium salts are present, the author finds that the amounts of calcium or magnesium carried down increase with the concentration of their salts present tending towards a limit corresponding with the chromites $Cr_2O_3,3CaO$ and $Cr_2O_3,3MgO$ respectively. The whole of the calcium may be removed by washing the precipitate on the filter with a boiling 5% solution of ammonium nitrate, whilst the magnesium is best removed by washing the precipitate by decantation with a similar solution. W. G.

Separation of Tin and Antimony in Hydrochloric Acid Solution by Means of Hydrogen Sulphide. G. LUFF (*Chem. Zeit.*, 1921, **45**, 229—231).—The effect of temperature, solution, concentration, etc., on the precipitation of antimony and tin sulphides was investigated. When a solution of antimony or tin containing 30 c.c. of concentrated hydrochloric acid is heated and treated with hydrogen sulphide, precipitation of the antimony sulphide begins at 80°, whilst the tin sulphide remains in solution even when the mixture is cooled to 25°. Ammonium chloride has a somewhat similar influence on the precipitation. W. P. S.

Separation of Tin and Antimony in Hydrochloric Acid Solution by Means of Hydrogen Sulphide. G. LUFF (*Chem. Zeit.*, 1921, **45**, 249—251, 254—255, 274).—The effect of adding increasing amounts of concentrated hydrochloric acid to boiling solutions of antimony and tin salts into which hydrogen sulphide is passed, is to lower the temperature at which precipitation occurs. With 30 c.c. per 100 c.c. of solution, separation of antimony trisulphide takes place at 95°; of the pentasulphide at 80°; and of stannic sulphide at 25°. Addition of 36 grams of ammonium chloride lowers the temperature at which precipitation is effected to 78° and 60°, respectively, with the trisulphide and pentasulphide of antimony; in the case of tin, no precipitation occurs even at normal temperature, until the solution has been allowed to remain. The best separation is realised with an addition of 14 c.c. of concentrated hydrochloric acid (D 1·193) to 100 c.c. of solution; the maximum and minimum concentrations are found to be 35 c.c. per 65 c.c. and 8 c.c. per 100 c.c. of solution. Vortmann-Metzel's and Panajotow-Prim's methods both give accurate results in the separation of antimonious salts. W. J. W.

Behaviour of Sodium Thioantimonate with certain Metallic Salt Solutions. A. LANGHANS (*Zeitsch. anal. Chem.*, 1921, **60**, 91—93).—Sodium thioantimonate solution yields the following reactions with various metallic salt solutions :—Aluminium, chromium, manganese, orange-red precipitates; zinc, cadmium, yellow precipitates; iron, nickel, cobalt, bismuth, black precipitates; silver, copper, lead, reddish-brown precipitates. With mercury salts, the coloration of the precipitate varies with the

salt; mercuric oxalate, mercuric oxide, and mercurous nitrate are blackened, whilst mercuric bromide gives a yellow precipitate. Mercuric cyanide yields a yellow precipitate which changes to black, and mercuric chloride gives a red precipitate which gradually changes to white. Mercury fulminate is at first coloured yellow, but this colour soon changes to green and finally to black. Mercury potassium iodide yields an orange-coloured, flocculent precipitate.

W. P. S.

The Estimation of Gold by Cupellation and the Examination of Large Quantities of Gold Destined for the Manufacture of Coinage. J. W. A. Haagen Smit (*Rec. trav. chim.*, 1921, **40**, 119—152).—A critical and detailed examination of the cupellation method for the analysis of gold bullion in which the author lays down certain details to which strict attention must be paid if accurate results are to be obtained. [See further *J. Soc. Chem. Ind.*, 1921, 263A.]

W. G.

Application of the Critical Temperature of Solution in Aniline to the Analysis of Light Petroleums. G. Chavanne and L. J. Simon (*Ann. Chim. anal.*, 1921, 3, 87—89).—The critical temperature of solution of the sample in aniline is determined, before and after the sample has been treated with a mixture of sulphuric and nitric acids and then washed with sulphuric acid to remove the nitrated aromatic hydrocarbons. The following formulæ then give the approximate composition of the petroleum: Aromatic hydrocarbons $(Ar)=1{\cdot}18(T_2-T_1)$; saturated cyclic hydrocarbons $(C)=72-(T_2-0{\cdot}2)/72-39{\cdot}5\times(100-Ar)$; acyclic hydrocarbons $(Ac)=100-Ar-C$, where T_1 and T_2 are the critical temperatures of solution before and after nitration respectively.

W. P. S.

Estimation of Benzene Hydrocarbons in Coal Gas. E. Berl, Karl Andress, and Wilhelm Müller (*Zeit. angew. Chem.*, 1921, **34**, 125—127).—An accurate method for estimating benzene hydrocarbons in coal gas, even when present in only small amount, consists in adsorbing them by charcoal, and then distilling them in steam. The apparatus consists of a U-tube, widened at its lower half, and having inlet- and outlet-tubes with taps fixed in its open ends. A layer of dry charcoal is placed in the tube over which the gas to be tested is passed, at a rate dependent partly on the content of benzene hydrocarbons, but approximately of 250 litres per hour. When adsorption is complete, one limb of the tube is connected with a steam supply, and to the other limb are attached a condenser and measuring burette; the tube is heated in a bath to 110—120°, in a current of steam, for about thirty minutes, and the distilled benzene hydrocarbon layer is measured. More accurate results are obtained by this method than by either the dinitrobenzene or the paraffin oil method; thus the proportion of benzene hydrocarbons in a sample of illuminating gas was found to be 20·2—23·9 c.c. per cub. m., as compared with 16·0—17·2 and 9·74—10·1 c.c. per cub. m., respectively, by the other two methods.

W. J. W.

A Sensitive Modification of the Iodoform Reaction for Alcohol. N. Schoorl (*Pharm. Weekblad*, 1921, **58**, 209—210).—Instead of potassium persulphate in presence of potassium iodide in alkaline solution, as suggested by Kunz (A., 1920, ii, 711), ammonium persulphate may be employed. The iodoform precipitate is in this case orange to red, without crystalline form, but passes into the yellow, crystalline modification after several days. In the new form, the reaction will detect one part of acetone in 100,000. S. I. L.

Rapid Volumetric Method for Estimating Ethyl Alcohol. Arthur Lachman (*J. Ind. Eng. Chem.*, 1921, **13**, 230).—To estimate the amount of ethyl alcohol in a water–alcohol mixture, 25 grams of aniline are added to 50 c.c. of the mixture; if the aniline does not dissolve completely, a known amount of alcohol must be added. The whole mixture is then titrated with water until a permanent turbidity is produced. During the addition of the water the temperature is kept at about 15°. The total volume of the solvent (alcohol plus water) is a nearly strictly linear function of the volume of the alcohol present; the latter volume is found by reference to a graph constructed from the results of estimations in which known amounts of alcohol were used. W. P. S.

Estimation, by Acetylation, of Borneol and its Acylated Derivatives. Félix Martin (*J. Pharm. Chim.*, 1921, [vii] **23**, 168—171).—Borneol may be converted completely into bornyl acetate by heating it at 145—150° for three hours with three times its weight of acetic anhydride and a small quantity of fused sodium acetate. After cooling, the mixture is diluted with water, the oily layer separated, washed with water, then with 5% sodium carbonate solution, again with water, and dried over anhydrous sodium sulphate. A weighed quantity of the acetylated substance is then saponified and the quantity of borneol calculated from the saponification value, allowance being made for the fact that the acetylation increases the molecular weight of the borneol by 42. W. P. S.

Sodium Fluoride or Citrate as Anti-coagulant in Estimating Blood Sugar. R. Clogne and A. Richaud (*Bull. Soc., Chim. Biol.*, 1921, **3**, 66—68).—With citrate, blood glycolysis continues and after twenty-four hours scarcely any sugar is left, but when coagulation is prevented by sodium fluoride, satisfactory results are obtained, even after four days. G. B.

Estimation of Maltose or Lactose in the Presence of other Reducing Sugars (use of Barfoed's Solution). Legrand (*Compt. rend.*, 1921, **172**, 602—604).—Barfoed's solution of copper acetate and acetic acid (this Journal, 1873, 1163) is reduced by hexose-sugars but not by the disaccharides. Estimations of hexose-sugars are best conducted by boiling 5 c.c. of the sugar solution, containing at the most 0·1 gram of sugar, with 15 c.c. of Barfoed's solution for three minutes in a conical flask, the cuprous oxide being subsequently collected and estimated volumetrically as in

Bertrand's method. If disaccharides are present, the total reducing sugars are then estimated by one of the usual methods with Fehling's solution. W. G.

Polarimetric Estimation of Starch. H. LÜHRIG (*Pharm. Zentr.-h.*, 1921, **62**, 141—144).—Ewer's method (A., 1908, ii, 543) yields trustworthy results, and the latter are not influenced to any great extent by slight differences in the procedure, particularly as regards the concentration of the acid. It is most important, however, that the time of heating (fifteen minutes) should not be altered, and in no case should it exceed sixteen minutes. A method described recently by Mannich and Lenz (Zeitsch. Nahr. Genussm., 1920, **40**, 1), in which the starch is dissolved in hot calcium chloride solution containing a small quantity of acetic acid, also yields trustworthy results. W. P. S.

Detection of Lactic Acid. L. HARTWIG and R. SAAR (*Chem. Zeit.*, 1921, **45**, 322).—A bright red coloration is obtained when 0·2 c.c. of a solution containing not more than 0·2% of lactic acid is heated for two minutes at 100° with 2 c.c. of concentrated sulphuric acid, then cooled, and treated with 2 drops of 5% alcoholic guaiacol solution. The reaction is not given by formic acid, acetic acid, malic acid, benzoic acid, or salicylic acid; citric acid gives a yellow coloration and tartaric acid a slight red coloration, whilst tannin yields a blackish-violet colour. W. P. S.

Estimation of Oxalic Acid and Oxaluric Acid in Urine and in Fæces. ARMINIUS BAU (*Biochem. Zeitsch.*, 1921, **114**, 221—257).—For the estimation of oxalic acid in urine, the clear solution is digested with a mixture of sodium acetate and calcium chloride for thirty-eight to forty-four hours, the calcium oxalate is then collected, incinerated, and titrated with $N/10$-hydrochloric acid. In order to estimate the oxaluric acid content of the urine, the oxalic acid is first estimated as described above, and then another portion is boiled for an hour with hydrochloric acid (D 1·125), filtered, nearly neutralised with ammonia and treated with the sodium acetate and calcium chloride mixture. The oxalic acid is then estimated in the same way as before. The difference between the oxalic acid obtained after the treatment with the hydrochloric acid and the original content of oxalic acid gives the oxaluric acid content of the urine. The fæces are dried, extracted with water and hydrochloric acid, filtered, and in the filtrate, after neutralisation with ammonia and treatment with ammonium citrate, the oxalic acid is estimated as above. S. S. Z.

Identification of Acids. VI. Separation of Acids by Means of Phenacyl Esters. J. B. RATHER and E. EMMET REID (*J. Amer. Chem. Soc.*, 1921, **43**, 629—636).—In continuation of previous work (A., 1920, i, 381), a number of illustrations chosen from naturally occurring organic acids are given to show that the constituents of a mixture of such acids may frequently be identified by preparation of their phenacyl esters from the sodium salts, followed by fractional crystallisation. J. K.

The Detection of Methyl Anthranilate in Fruit Juices. FREDERICK B. POWER (*J. Amer. Chem. Soc.*, 1921, **43**, 377—381).—Five hundred c.c. of the juice are steam distilled, 200 c.c. of distillate being collected. The distillate is extracted with three successive 10 c.c. of chloroform, the extract being passed through a dry filter and the chloroform carefully evaporated on a water-bath in a current of air. The residue is at once dissolved in 2 c.c. of 10% sulphuric acid, the solution cooled, and one drop of a 5% solution of sodium nitrite is added, the excess of nitrous acid being subsequently destroyed by the addition of carbamide. The diazotised solution is added to a mixture of 1 c.c. of 0·5% β-naphthol solution, 1 c.c. of 10% sodium hydroxide, and 1 c.c. of 10% sodium carbonate (monohydrated). A yellowish-red precipitate is obtained if methyl anthranilate was originally present in the juice, the test being sensitive to 0·0001 gram of the ester. Alternatively, the diazotised liquid may be tested with dimethylaniline, but this is not so sensitive as the β-naphthol. W. G.

Detection of Acetone by Degradation to Derivatives of Formic Acid. EMILIO PITTARELLI (*Policlinico*, 1920, **27**, 1047—1049; from *Chem. Zentr.*, 1921, ii, 536).—Acetone is converted by chlorine, bromine, or iodine in strongly alkaline solution into chloroform, etc. Excess of free halogen is removed and the haloid is detected by warming with phenol and subsequent heating with alkali hydroxide, by the carbylamine reaction, or by reduction to acetylene (with zinc and ammonium chloride). H. W.

Colour Reaction of Indones. REMO DE FAZI (*Gazzetta*, 1921, **51**, i, 164—169).—The green coloration obtained by the action of concentrated sulphuric acid on various lactic and cinnamic acid derivatives is shown to be due to the formation from these derivatives of indones, which are capable of combining with sulphuric acid at the double linking of the cyclostatic group, $\cdot CO\cdot\underset{|}{C}:\underset{|}{C}—$, giving intensely coloured compounds; the reaction is not shown by hydrindones. Further, it seems probable that indene derivatives of the type 2 : 3-diphenylindene containing the cyclostatic group, $\cdot CH_2\cdot\underset{|}{C}:\underset{|}{C}H$, also give the colour reaction with sulphuric acid. Since stable acids derived from cinnamic acid furnish no coloration, the reaction may be used to distinguish stable cinnamic acids from the allo-compounds. T. H. P.

Detection of "Saccharin." A Correction. L. THEVENON. (*J. Pharm. Chim.*, 1921, [vii], **23**, 215).—The author finds that a reaction he described recently (this vol., ii, 69) is not characteristic of "saccharin." β-Naphthol, one of the reagents used, yields a red coloration with nitrous acid in dilute acid solution, even in the absence of "saccharin." W. P. S.

Separation of *o*- and *p*-Toluenesulphonamides. WALTER HERZOG and I. KREIDL (*Chem. Zeit.*, 1921, **45**, 231).—Separation of the two sulphonamides, as proposed by O. Beyer, by means of 10% sulphuric acid is not possible; both the sulphonamides are soluble in this acid. If, however, *o*-sulphonamide containing not

more than 2% of *p*-sulphonamide is dissolved in hot 10% sulphuric acid and the solution cooled, the *p*-sulphonamide crystallises out, leaving the greater part of the *o*-sulphonamide in solution.

W. P. S.

Detection of Volatile Alkylamines in the Presence of Ammonia and of Volatile Tertiary Alkylamines in the Presence of Volatile Primary and Secondary Alkylamines. H. E. Woodward and C. L. Alsberg (*J. Biol Chem.*, 1921, **46**, 1—7).—Incipient decomposition of foodstuffs may be recognised by the presence of traces of amines, which are, however, difficult to distinguish from the ammonia also present. In dilute alkaline solution, ammonia reacts with formaldehyde to form hexamethylenetetramine, but methylamines furnish methyl alcohol and formic acid. The formic acid is detected by a solution containing 180 grams of mercuric bromide and 120 grams of potassium bromide per litre, which gives, on warming, a white precipitate of mercurous bromide when 0·5 mg. of amine-nitrogen is present. Ammonia and mono- and di-methylamine also give a white precipitate with mercuric bromide, but this is soluble in excess of formaldehyde.

Trimethyl- and triethyl-amine form with potassium mercuric iodide (450 grams of HgI_2 and 330 grams of KI per litre) yellow, crystalline compounds melting at 136° and 77° respectively, if excess of potassium iodide is avoided. Trimethylamine is still precipitated at 3 mg. in 5 c.c.; dimethylamine requires to be at least six times as concentrated. At suitable concentrations the tertiary amine only is precipitated, and then may be obtained pure, by distilling the mercuri-iodide with sodium hydroxide and sulphide (compare Weber and Wilson, A., ii, 377; Bertheaume, A., 1908, ii, 742; 1910, i, 365; ii, 663, 808; François, A., 1904, i, 151; 1905, i, 574; 1906, i, 484, 644; 1907, i, 391; ii, 503). G. B.

A Colour Reaction of Glycine Anhydride and the Dipeptide Anhydrides containing Glycyl Components. Takaoki Sasaki (*Biochem. Zeitsch.*, 1921, **114**, 63—66).—Glycine anhydride, creatinine, and certain related compounds as well as many other substances give a colour reaction with picric acid when heated. In these reactions it is preferable to use sodium carbonate instead of alkali hydroxide. Substances which are slightly soluble in water are dissolved in alcohol and treated with alcoholic picric acid. The use of this colour reaction in the estimation of sugar may easily lead to error, especially in the case of minimal amounts of sugar in pathological blood samples. S. S. Z.

The Removal of Ammonia from Urine Preparatory to the Determination of Urea. Guy E. Youngburg (*J. Biol. Chem.*, 1921, **45**, 391—394).—The ammonia is removed by adsorption by permutite. (See Folin and Bell, A., 1917, ii, 268.) J. C. D.

An Improved Apparatus for Use in Folin and Wu's Method for the Estimation of Urea in Blood. Thomas Watson and H. L. White (*J. Biol. Chem.*, 1921, **45**, 465—466).—The apparatus is designed to counteract foaming during the distilla-

tion of the ammonia; the bulbed tube connecting the flask to the condenser projects some way below the cork, the end is constricted, and a number of small holes are blown in the side. In passing through these the large bubbles are broken up. J. C. D.

Non-protein Nitrogen of Human Blood. II. [The Satisfactory Estimation of the Urea Fraction.] JOH. FEIGL (*Zeit. ges. expt. Med.*, 1921, **12**, 55—133; from *Chem. Zentr.*, 1921, ii, 692).—The estimation of urea by the ordinary sodium hypobromite method cannot be depended on. The exact estimation of urea, which is of considerable importance in blood investigations, can only be effected by the urease and xanthydrol methods.

G. W. R.

Characteristic Reaction for the Detection of Mercury Fulminate. A. LANGHANS (*Zeitsch. anal. Chem.*, 1921, **60**, 93—94).—If mercury fulminate is moistened with alcohol, then with water, and shaken with sodium thioantimonate solution, a yellow precipitate is obtained; this becomes green and then black. The filtrate from this precipitate deposits white, glistening crystals and when treated with nitric acid yields a red coloration which is soluble in ether. W. P. S.

Detection of Small Quantities of Hydrocyanic Acid from Cyanogenetic Glucosides. G. DENIGÈS (*Compt. rend. Soc. Biol.*, **84**, 309—310; from *Chem. Zentr.*, 1921, ii, 623).—Hydrocyanic acid is detected by the formation of oxaluramide by the simultaneous action of ammonia and alloxan. The alloxan reagent is made by gently heating 1 gram of pure uric acid, 1 c.c. of nitric acid (D 1·39—1·40), and 1 c.c. of water until clear; 50 c.c. of water are then added. The substance under examination is mixed with an equal weight of water and left for one hour in a tall, narrow glass tube on the end of which is placed a watch glass carrying a drop of the above reagent. In the presence of hydrocyanic acid, a coloration is observed due to the presence of oxaluramide in a star-shaped crystals. The reaction is more delicate if pyridine is used in the place of ammonia. A red colour is often observed due to murexide formed by the action of dialuric acid (accompanying oxaluramide) on excess of alloxan. G. W. R.

Origin, Development, and Value of the Thalleioquinine Reaction. WM. BEAUMONT HART (*J. Soc. Chem. Ind.*, 1921, **40**, 72—73T).—The earliest published record of the green coloration produced by treating a quinine solution with chlorine and ammonia is made by Meeson (*Phil. Mag.*, 1835, 158) and the reaction has since been modified in various ways (substitution of bromine for chlorine, etc.). The author finds that excess of bromine is detrimental, the greatest depth of colour being given by 6 atoms of bromine per molecule of quinine; the reaction is very sensitive, the mit being 1 : 250,000 in a depth of 2·25 inches of solution, but with so many variables the reaction is untrustworthy for quantitative work. W. P. S.

Rapid Method for Estimation of Morphine in Opium and Opium Preparations. TRIFÓN UGARTE (*Anal. Soc. Quim. Argentina*, 1920, **8**, 268—270).—The alcoholic extract of the substance under examination is evaporated to dryness and maintained at 100° to render resins insoluble. After extraction with cold water, the residue from the evaporation of the filtrate is treated with a saturated solution of morphine and a normal solution of ammonia saturated with morphine. The resulting solution is shaken with successive portions of ether. Crystals of morphine are obtained in the aqueous portion. These are collected, washed with water saturated with morphine and ether, dried, and weighed.

G. W. R.

A Reaction to Distinguish between Theobromine and Caffeine. M. MALMY (*J. Pharm. Chim.*, 1921, [vii], **23**, 89—91).—The difference in the behaviour of theobromine bismuthoiodide, and the corresponding compound of caffeine towards the reducing action of hydriodic acid, may be used to differentiate between these two substances. The test is conveniently performed as follows: 0·05 gram of theobromine or caffeine is shaken with 10 c.c. of water and 0·5 c.c. of fresh potassium bismuthoiodide solution. In each case an orange-coloured precipitate is obtained, and 5 drops of a 10% tincture of iodine (not freshly prepared, so that it may contain a small proportion of hydriodic acid) are added. The caffeine bismuthoiodide precipitate changes in colour to a bright red, whilst the theobromine precipitate becomes brown in fifteen minutes, and dark chocolate brown in less than thirty minutes, owing to reduction. A dilute solution of hydriodic acid containing not more than 1% of hydrogen iodide may be used instead of the tincture of iodine if desired.

G. F. M.

Estimation of Yohimbine in Yohimba Bark. ARNOLD SCHOMER (*Pharm. Zentr.-h.*, 1921, **62**, 169—171).—Fifteen grams of the powdered bark are shaken for ten minutes with 150 grams of ether, 10 grams of 15% sodium hydroxide are added, the mixture is shaken, and, after one hour, 100 grams of the ethereal solution are shaken with successive quantities of 1% hydrochloric acid. The acid extracts are shaken with 25 c.c. of chloroform, this is separated, the acid solution then rendered alkaline with sodium carbonate solution and extracted with chloroform; the chloroform extract is evaporated and the residue obtained is dissolved in a small quantity of alcohol and a few drops of hydrochloric acid, the alcohol is evaporated, 5 c.c. of ether are added, this is also evaporated, and the residue warmed with 50 drops of alcohol. After a further evaporation, which is carried almost to dryness, the crystalline residue is treated with 50 grams of chloroform, cooled at 0°, and the crystals are then collected, dried at 100°, and weighed.

W. P. S.

Estimation of Amylase. L. AMBARD (*Bull. Soc. Chim. Biol.*, 1921, **3**, 51—65).—See this vol., i, 368.

General and Physical Chemistry.

Theory of Molecular Refractions. I. GERVAIS LEBAS (*Chem. News*, 1921, **122**, 194—196).—The relation between refractivity and valency is considered. Augmentation may be due both to substitution and to unsaturation. The activation of supplementary valencies may be due to the influence of unsaturated atoms other than carbon. Atoms of high atomic weight are more likely to activate one another than those of low, and the effects are greater when the atoms are united by an unsaturated group.
J. R. P.

Additive Properties of Salts of Organic Acids. MARÍA L. LECCE DE GARCÍA (*Ann. Soc. Quím. Argentina*, 1920, **8**, 381—392. Compare Bernaola, this vol., ii, 285).—The application of the law of moduli is less exact the more carbon atoms are contained in the acid radicle of a salt. Moduli obtained from the consideration of the properties of normal solutions cannot be used for the calculation of the properties of solutions of different concentrations. Additive properties are best exemplified in the case of the refractive indices of salts of the first three members of the fatty acid series. Specific refractive powers for salts containing less than a certain proportion of carbon (30 to 37·4%, according to the formula used for the calculation of this value) increase with decreasing concentration. Absolute refractive power increases in ascending an homologous series. The effect of constitution is very marked, the benzene nucleus having a much greater effect on refractive power than would be expected from its containing six carbon atoms. G. W. R.

The Specific Dispersion of Hydrocarbons. E. DARMOIS (*Compt. rend.*, 1921, **172**, 1102—1105).—The approximate constancy of the specific dispersion for each series of hydrocarbons, as determined experimentally (this vol., ii, 1) is now confirmed theoretically by calculation from the atomic refractions. The agreement is not quite satisfactory when the hydrocarbons contain one or more ethylenic linkings. W. G.

A Spectroscopic Confirmation of the Isotopes of Chlorine. A. KRATZER (*Zeitsch. Physik*, 1921, **4**, 476).—An addition to the author's previous paper (this vol., ii, 142) consisting of references to further work on the spectra of isotopes which had been done prior to the appearance of the author's paper. J. F. S.

The Iodine Molecule and the Emission of its Band Spectrum. W. STEUBING (*Ann. Physik*, 1921, **64**, [iv], 673—691).—The positive column of an iodine tube with carbon electrodes has been spectroscopically examined when under the influence of a magnetic field and other sources of energy. The influence of a magnetic field is

to produce a band spectrum in which the energy maximum is displaced toward longer wave-lengths. The band spectrum is to be attributed to the iodine molecule, since it can be produced by fluorescence without simultaneous ionisation and dissociation. It also appears when ionisation takes place if the exciting cause is one of small energy content, but if the energy content is great the band spectrum disappears and a line spectrum takes its place. The band spectrum is produced by the combination of a negative electron with the molecule. Hence, for the character of the spectrum, it is of no importance whether the electron comes from the molecule itself (fluorescence) or from outside as a free electron (cathode rays). In both cases the magnetic field accelerates the combination.

J. F. S.

Spectra of some Compound Gases in Vacuum Tubes. W. H. BAIR (*Astrophys. J.*, 1920, **52**, 301—316).—Photographic observations were made of the spectra of ammonia, nitrous oxide, nitrogen peroxide, carbon dioxide, hydrogen sulphide, and sulphur dioxide, a regular flow of the gas through the discharge tube being maintained. The well-known ammonia band in the visible spectrum is found to have two heads, each degraded in both directions; the differences between this band and that at λ 3371 Å. suggest that the latter may be due to some other compound. Both oxides of nitrogen show strongly the third positive group of nitrogen bands, observed from λ 1902 Å. to λ 3458 Å.; those at the more refrangible end depart from Deslandres's law. Of the two negative groups of carbon bands, the first is probably due to carbon monoxide and the second, including several new bands, to carbon dioxide. The spectrum of sulphur dioxide is extended to λ 2124 Å. by the tabulation of forty new bands. CHEMICAL ABSTRACTS.

Spectrum of Helium in the Extreme Ultra-violet. HUGO FRICKE and THEODORE LYMAN (*Phil. Mag.*, 1921, [vi], **41**, 814—817).—By improved experimental methods a fairly strong line at 585 A.U. has been located, the resonance potential of which, 21·2 volts, agrees with the results of Franck and Knipping. It is concluded that, apart from the lines at 1640 Å.U. and 1215 Å.U. belonging to the enhanced spectrum but of doubtful origin, only one line can be ascribed with certainty to helium in the extreme ultra-violet. Other lines described by different experimenters are probably due to impurities. J. R. P.

Revision of the Series in the Spectrum of Calcium. F. A. SAUNDERS (*Astrophys. J.*, 1920, **52**, 265—277. Compare A., 1920, ii, 522).—Singlets and triplets, and their combinations in the calcium spectrum have been studied and extended. There are no known combinations of these with the doublets; the latter may be associated with a different vibrating mechanism, for example, Ca^+. The diffuse series of triplets exhibits curious anomalies. Four triple-series of each system were found, and three possible inter-system combination series. CHEMICAL ABSTRACTS.

Vacuum Hot-spark Spectrum of Zinc in the Extreme Ultra-violet Region. R. A. SAWYER (*Astrophys. J.*, 1920, **52**, 286—300).—With the use of an apparatus consisting of an evacuated brass cylinder containing electrodes, grating, slit, and plate holder, and by sparking intermittently under specified conditions, eighty new lines were observed of wave-lengths between 316 Å. and 1400 Å., and about twenty between 1400 Å. and 2200 Å. ($\pm$ 0·5 Å).

CHEMICAL ABSTRACTS.

The Luminescence of Samarium. HORACE L. HOWES (*Physical Rev.*, 1921, **17**, 60—63).—The effect was investigated of previous heat treatment on the luminescence spectrum obtained from samarium oxide mixed with a large excess of lime at 20° by excitation with cathode rays. With fresh preparations pre-heated (*a*) at 200° there was no luminescence at all; (*b*) at 400°, but few regions of luminescence were observed; (*c*) at 600°, the luminescence was sufficiently bright for spectrum analysis; (*d*) at or above 1200° the spectrum was of maximum brilliance. Variation in the duration of heat treatment between one and three hours had no effect. The luminescence spectrum consists of bands of varying intensities, which, plotted to a frequency scale, can be resolved into nine series of constant frequency intervals varying slightly for different series. A table shows the wave-length and reciprocal of wave-length of each band, together with the relative intensity and series letter. No shift in the position of the bands could be measured, whether the specimen was heated at 600° or 3000°. This remarkable stability is not generally associated with a luminescent substance. The minimum temperature for thermo-luminescence was about 200°.

CHEMICAL ABSTRACTS.

The *X*-Ray Spectra of Tungsten. WM. DUANE and R. A. PATTERSON (*Physical Rev.*, 1920, **16**, 526—539. Compare this vol., ii, 145; A., 1920, ii, 2, 407; A., 1919, ii, 358 and 488).—Measurements are tabulated for the critical absorption wave-lengths of the *K* and *L* series and the emission wave-lengths of the *L* series. The assumption of Sommerfeld that if some of the orbits are elliptic in certain atoms and circular in others the *K* critical absorption frequency should be complex, is not confirmed. Also if this assumption is correct, the difference between the *K* absorption frequency and one of the *L* absorption frequencies should not be equal to a K_a emission frequency, whereas this equality is shown to exist. The experimental data accord with Sommerfeld's expression for the frequency of the *L* series doublet.

CHEMICAL ABSTRACTS.

Precision Measurements in the *L* Series of the Heavier Elements. DIRK COSTER (*Zeitsch. Physik*, 1921, **4**, 178—188).—The lines of the *L* series spectrum have been measured for the elements tungsten, osmium, iridium, platinum, gold, thallium, lead, thorium, bismuth, and uranium by Siegbahn's method. The results are tabulated and show the presence of a new *L* doublet (β_6 and γ_5). The value of β_6 has been determined in the case of five of the elements and a tungsten line, noted by Siegbahn as doubtful, fits into this new

doublet very well. In the case of platinum, β_6 must fall very near to β_4, so that the existence of β_6 can be taken as known for seven elements. The intensity of β_6 lies between that of β_4 and β_5. The harder constituent, γ_5, is much weaker and has an intensity less than that of γ_4. In the case of platinum, gold, and thallium, a softer and very weak line, β_7, is found. It is also shown that the Λ-doublet does not exist. There is a possibility that an exact additive relationship exists between K_{β_1}, K_{β_3} and M_β. J. F. S.

Spark Spectra of Gold and Platinum in the Extreme Ultra-violet. LÉON BLOCH and EUGÈNE BLOCH (*Compt. rend.*, 1921, **172**, 962—964).—The spark spectra of gold over the range $\lambda=1850$ to 1401 and of platinum over the range $\lambda=1843$ to 1461 are given. W. G.

The Effect of Fluorescence and Dissociation on the Ionising Potential of Iodine Vapour. H. D. SMYTH and K. T. COMPTON (*Physical Rev.*, 1920, **16**, 501—513. See A., 1920, ii, 723).—Since fluorescence is not accompanied by ionisation, it presumably results from the temporary displacement of an electron to one of the outer orbits; if this is so, less work should be required to ionise a fluorescing than a normal atom or molecule. In the curve obtained with fluorescing iodine vapour, three breaks are observed, occurring (*a*) at 6·42 volts, attributed to the ionisation of fluorescing iodine molecules; (*b*) at 7·67 volts, attributed to the ionisation of iodine atoms, and (*c*) at 9·07 volts, presumably due to the ionisation of normal, unexcited, diatomic iodine vapour. The mean difference between the values of (*a*) and (*c*) should be equal to the difference in the work needed to remove an electron from a fluorescent and a normal molecule; this value has previously been theoretically determined at about 2·3 volts. In the ionisation curve of unexcited atomic iodine, breaks occur at (*b*) 8·7 volts and (*c*) 10·16 volts, or an average value for all experiments of (*b*) 8·0 volts and (*c*) 9·4 volts, from which it is inferred that ionisation of the iodine molecule is accompanied by dissociation, as predicted by Bohr's theory for hydrogen and previously observed by Mohler and Foote (A., 1920, ii, 464) and by Franck, Knipping, and Krüger (A., 1920, ii, 145). The results are in accord with the view of Perrin (A., 1919, ii, 177) that quanta of radiant energy are emitted or absorbed in all chemical reactions. CHEMICAL ABSTRACTS.

Connexion between the Colour of Chemical Compounds and the Structure of the Molecule. JAKOB MEISENHEIMER (*Zeitsch. physikal. Chem.*, 1921, **97**, 304—318).—The author, on the basis of Kossel's hypothesis of the dependence of molecule formation on atomic structure (A., 1916, ii, 243), has put forward an hypothesis to explain why the chlorides of metals and the hydrochlorides of organic bases are so often white, whilst the corresponding iodides and hydriodides vary in colour from yellow to red. According to Kossel's hypothesis, when sodium combines with chlorine to form sodium chloride, the former element gives up its single valency electron to the chlorine, and the chlorine then, by

means of its own seven valency electrons and the electron from the sodium, takes up a form similar to an inactive gas. But iodine having a larger atomic volume than chlorine, and therefore a smaller attractive force between the nucleus and the outside electron sheath, is unable to take an eighth electron into its outer sheath from a metal in the same way as chlorine. Hence an irregular sheath of electrons is formed which is so unstable that the feeble energy of visible light is able to displace the electrons from their paths and so the compound must be coloured. In the same way, the author considers that the yellow and red varieties of mercuric iodide are isomeric because the iodine valency electrons possess different orbits. J. F. S.

Colour and Chemical Constitution. XI. A Systematic Study of the Brominated Phenolphthaleins regarding the Relation between Position and Colour. JAMES MOIR (*Trans. Roy. Soc. S. Africa*, 1921, **9**, 129—136. Compare this vol., p. ii, 6).—The general formula previously derived (A., 1920, ii, 573) reduces, in the case of bromophenolphthaleins, to the form $\lambda=554+7{\cdot}091(m+0{\cdot}091m^2)$, m being the number of ortho-bromine atoms; in the case of meta-bromine atoms, m is to be doubled. Experimental data for five mono-, five di-, three tri-, two tetra-, three penta-, four hexa-, and one hepta-bromophenolphthaleins are shown to be usually within one unit of the values calculated from the above formula, together with additive coefficients which are given for substituents to which it does not apply. New monochloro- ($\lambda=564$) and monoiodo- ($\lambda=568{\cdot}5$) -phenolphthaleins derived from the meta-halogenated phenols were also examined. The negative effect of the para-substituent previously noted in the case of benzaurine derivatives, is not observed in the phenolphthalein series, and it is therefore suggested that the usual formulæ for phenolphthalein and also fluorescein in alkaline solution require such amendment as will make them wholly phenolic in character, and not containing the $-CO_2Na$ grouping. J. K.

The Photochemical Reaction between Hydrogen and Chlorine and its Variation with the Intensity of the Light. EDWARD CHARLES CYRIL BALY and WILLIAM FRANCIS BARKER (T., 1921, **119**, 653—664).

Photochemical Transformations in the Triphenyl-methane Series and Photo-concentration Cells. I. LIFSCHITZ and CH. L. JOFFÉ (*Zeitsch. physikal. Chem.*, 1921, **97**, 426—444).—Solutions of the leuco-cyanides of pararosaniline, crystal-violet, victoria-blue, malachite-green, and brilliant-green and the carbinol bases of crystal-violet and malachite-green in ethyl alcohol, ether, benzene, and chloroform have been exposed to the action of light from a quartz mercury lamp and the colour changes noted. In all cases, except that of the leuco-cyanide of victoria-blue, the originally colourless or at most faintly coloured solution became intensely coloured. In the case of victoria-blue, the solution showed no colour change until a temperature of 35—40° had been reached, and then the change was very slight; at 78°, the reaction reached its optimum

value. The reactions in all cases took place more slowly in ether and benzene than in alcohol. The reaction in the dark was very slow, but it was strongly catalysed by the presence of potassium hydroxide or potassium cyanide. It is shown that the reaction is reversible in all cases and consequently is to be regarded as an energy-storing reaction. The specific conductivity of some of the solutions has been determined at various periods after preparation, and in this way the stationary condition has been determined both for the light and the dark reactions. It is shown that the active portion of the light is that composing the long wave-length portion of the ultra-violet. The dark reactions are readily catalysed and the formation of molecular compounds plays an important part in the catalysed reaction. Photo-concentration cells of the type Electrode (2nd kind)|Solution (dark)||Solution (bright)|Electrode (2nd kind) have been measured. It is shown that considerable *E.M.F.* values may be obtained. Thus the cell Ag,AgCN|*p*-rosaniline leuco cyanide (dark)||*p*-rosaniline leuco-cyanide (light)|AgCN,Ag gave an *E.M.F.* of 0·213 volt, whilst the leuco-cyanide of malachite-green gave the value 0·224 volt. The *E.M.F.* values became steady in a few minutes after the illumination commenced. In the case of the carbinol base, the electrode Ag,Ag_2O| was used, and in these cases a very small *E.M.F.* was obtained. J. F. S.

The Existence of Helium Nuclei in the Nuclei of Radio-active Elements. F. Brösslera (*Rev. Chim.*, 1921, **1**, 42—48, 74—80).—The mass of a helium nucleus is less than that of the four hydrogen nuclei, from which it may be supposed to be formed, by an amount $\Delta m=4\times1{\cdot}0077-4{\cdot}002=0{\cdot}029$. This corresponds with a loss of energy during the condensation of the hydrogen nuclei of $0{\cdot}029c^2$ per gram-atom of helium formed (c=velocity of light). Consequently, it is unnecessary to suppose that helium nuclei pre-exist in the nuclei of radioactive elements in order to account for the kinetic energy possessed by α-particles, for part of the energy liberated during the formation of helium nuclei within the atom from pre-existing hydrogen nuclei might be utilised in detaching the α-particles so formed and imparting to them their momentum. C. K. I.

The Degradation of Gamma-Ray Activity. Arthur H. Compton (*Phil. Mag.*, 1921, [vi], **41**, 749—769).—The greater part of the secondary γ-radiation from matter traversed by hard γ-rays from radium *C* is fluorescent in character. It is harder and more intense at small angles with the incident beam. At large angles, the radiation from heavy elements is somewhat more penetrating than that from light elements, but at small angles the hardness and intensity are approximately the same from elements covering a wide range of atomic numbers. The wave-length of the softest parts of the radiation lies between 0·06 and 0·12 Å.U., probably nearer the former value, whilst the wave-length of the hardest part is probably about half as great. The effective wave-length of the hard γ-rays from radium is estimated as about 2 or 3×10^{-10} cm.

J. R. P.

The Absorption of X-Rays. TYCHO E:SON AURÉN (*Medd. K. Vetenskapsakad. Nobel-Inst.*, 1920, **4**, No. 3, 1—44).—The relative absorption coefficients for X-rays of a number of elements have been determined by a method previously described (A., 1917, ii, 350). The law of additive absorption was confirmed. With the possible exception of carbon, the state of aggregation appears to have no influence on the quantity of absorption. In compounds containing an element with different valencies, no difference in the absorptions was found. The relation between the atomic absorption coefficients for most elements from hydrogen to barium, and lead, with the absorption coefficient of copper as standard, have been determined at the mean wave-lengths 0·38, 0·36, 0·34, and 0·30 (10^{-8} cm.). On the assumption that the absorption with hydrogen is exclusively due to scattering produced by the one electron associated with the nucleus, the conclusion is drawn that the effect with other elements is due to the outer electrons, and the number of these was calculated as follows: hydrogen 1, lithium 3, glucinum 4, boron 5, carbon 4, nitrogen 7, oxygen 4, fluorine 5, sodium 7, magnesium 4, aluminium 5, silicon 4, phosphorus 7, sulphur 4, chlorine 5, potassium 7, calcium 4. The atomic absorption coefficient increases almost in proportion to the atomic number. The number of outer electrons in the lightest elements seems to be the same for elements in the same vertical row in the periodic system. J. R. P.

Scattering and Absorption of Hard X-Rays in the Lightest Elements. TYCHO E:SON AURÉN (*Medd. K. Vetenskapsakad. Nobel-Inst.*, 1920, **4**, No. 5, 1—12; *Phil. Mag.*, 1921, [vi], **41**, 733—743).—The atomic absorption coefficients of carbon, hydrogen, nitrogen, and oxygen relative to the molecular absorption coefficient of water were determined. The results did not agree with the theories of Thomson, according to which the scattering effect is independent of wave-length, or of Schott, according to which the mass-scattering coefficient should approach a constant value. The results were in agreement with the theory of Compton (A., 1919, ii, 504). In the case of lighter elements as far as and including nitrogen, the absorption can be considered chiefly as a scattering effect, the true absorption being very small. True absorption is proportionally greater with oxygen than with lighter elements, which is taken to indicate that the outer electrons are four in number in that element.

J. R. P.

Action of Röntgen Rays on Chloroform Solutions of Iodoform. L. BAUMEISTER and R. GLOCKER (*Zeitsch. physikal. Chem.*, 1921, **97**, 368—375).—The authors have studied the action of Röntgen rays on a 2% solution of iodoform in chloroform with the object of ascertaining whether or no the amount of iodine liberated constitutes a measure of the intensity of the radiation. The experiments show that the amount of iodine liberated in no way represents the energy of radiation, as has been hitherto assumed. The action of the Röntgen rays is not to liberate iodine, but rather to loosen it; the major portion of the iodine liberated is due to a

secondary reaction which has a velocity that is entirely independent of the quality and quantity of the radiation. Consequently this reaction may not be used as a measure of the energy of the radiation.

J. F. S.

Radiating and Ionisation Potentials of Hydrogen. K. T. COMPTON and P. S. OLMSTEAD (*Physical Rev.*, 1921, **17**, 45—53).—To detect and distinguish between radiation and ionisation, a modification of Lenard's method was used. Both radiation and ionisation are obtained at about 10·8 volts, probable radiation at about 13·4 volts, and strong ionisation at 15·9 volts. Discrepancies in experimental results are ascribed to the possibility of the following effects occurring together: radiation from free atoms near 10·8 volts, and ionisation near 13·5 volts; ionisation without dissociation of molecules near 10·8 volts, dissociation with radiation from one of the atoms near 13·4 volts, and dissociation with ionisation of one atom near 15·9 volts.

CHEMICAL ABSTRACTS.

Ionisation and Resonance Potentials of some Non-metallic Elements. F. L. MOHLER and PAUL D. FOOTE (*U.S. Bureau of Standards, Sci. Papers*, 1920, No. **400**, 669—700. Compare this vol., ii, 8; also A., 1918, ii, 94; A., 1919, ii, 42; A., 1920, ii, 464 and 524).—The following values have been obtained for ionisation potentials (V_i) and resonance potentials (V_r):—For phosphorus, $V_r=5{\cdot}80\pm0{\cdot}1$ volts; $V_i=13{\cdot}3\pm0{\cdot}5$ volts. For iodine, $V_r=2{\cdot}34\pm0{\cdot}2$ volts; $V_i=10{\cdot}1\pm0{\cdot}5$ volts. For sulphur, $V_r=4{\cdot}78\pm0{\cdot}5$ volts; $V_i=12{\cdot}2\pm0{\cdot}5$ volts. For nitrogen, $V_r=8{\cdot}18\pm0{\cdot}1$ volts; $V_i=8{\cdot}7+8{\cdot}18=16{\cdot}9\pm0{\cdot}5$ volts. For oxygen, $V_r=7{\cdot}91\pm0{\cdot}5$ volts; $V_i=7{\cdot}9+7{\cdot}6=15{\cdot}5\pm0{\cdot}5$ volts. For hydrogen, First $V_r=10{\cdot}4\pm0{\cdot}5$ volts; First $V_i=13{\cdot}3\pm0{\cdot}5$ volts; Second V_r=about 12·2 volts; Second $V_i=16{\cdot}51\pm0{\cdot}5$ volts. Bohr's theory gives, for the hydrogen atom, $V_r=10{\cdot}16$ and $V_i=13{\cdot}54$; for the hydrogen molecule, $V_i=16{\cdot}26$. The difference between these ionisation potentials is therefore as follows: observed, $3{\cdot}24\pm0{\cdot}5$ volts; calculated by Bohr, 2·72 volts; calculated from Langmuir's heat of dissociation (A., 1914, ii, 104), 3·90 volts. There is no evidence that any of the ionisation potentials measured are " negative ionisation potentials " required to remove an electron from a negatively charged ion to form a neutral molecule.

CHEMICAL ABSTRACTS.

Ionisation of Gases during Chemical Reactions. II. A. PINKUS and M. DE SCHULTHESS (*J. Chim. phys.*, 1920, **18**, 366—411; *Helv. Chim. Acta*, 1921, **4**, 288—295. Compare A., 1918, ii, 286).—Making use of the method previously described, the authors have ascertained the amount of ionisation which occurs when certain gaseous reactions are allowed to take place at the ordinary temperature. The reactions studied are, the formation of nitrosyl chloride from chlorine and nitric oxide, the decomposition of ozone, and the reaction between ozone and nitric oxide and nitrogen dioxide respectively. In the case of the combination of chlorine and nitric oxide, it is shown that at ordinary temperatures bi-polar nucleii are emitted, the emission being entirely due to the chemical reaction itself, and not in any way influenced by any physical process.

Generally, the ionisation is very intense, but the number of charged particles received by the electrode is always very much less than the number of nitrosyl chloride molecules formed. This is explained, at least in part, by the recombination of the ions before they reach the electrode. The ionisation is favoured by an excess of chlorine, the strongest effect being observed when 1 to 4 volumes of chlorine are mixed with one volume of nitric oxide. The number of charges received by the electrode in a given time is independent of the pressure of the reacting mixture. The ionisation persists generally for a few minutes only, and its intensity decreases much more rapidly than the rate of formation of the nitrosyl chloride. The results generally indicate that the ionisation is brought about by the reaction of at least one molecule of chlorine with one molecule of nitric oxide and it occurs more rapidly than the reaction $2NO+Cl_2=2NOCl$. The decomposition of ozone at ordinary temperatures is accompanied by a bi-polar ionisation which is probably to be attributed to the decomposition itself. The ionisation in this case is very intensive, particularly when the reaction occurs in the presence of a large excess of chlorine. As in the preceding case, the number of charged particles received by the electrode is much less than the number of molecules which have reacted. In the presence of chlorine, the intensity of ionisation becomes greater as the volume ratio $Cl_2:O_3$ is increased. The action of chlorine in the reaction is a purely catalytic one. The ionisation diminishes somewhat with an increase in the pressure of the reacting mixture, and it persists from one to three minutes in the presence of a large excess of chlorine, whilst in pure ozone or ozone slightly diluted with chlorine it is much less persistent. The ionisation diminishes more rapidly as the reaction causing it is more rapid. The reactions between concentrated ozone and nitric oxide or nitrogen dioxide take place with the evolution of light and very often partake of the character of an explosion, even when the quantity of ozone present is very small. In the case of the reaction with nitrogen dioxide, a very strong bi-polar ionisation accompanies the reaction, which appears to be due entirely to the reaction itself, but this is not quite certain, because the product of the reaction, nitrogen pentoxide, is solid and because of the violence with which the reaction takes place. J. F. S.

Ionisation of Gases during Chemical Reactions. III. A. Pinkus (*J. Chim. phys.*, 1920, **18**, 412—413. Compare preceding abstract).—The author points out that the reason for the failure of Trautz and Henglein (A., 1920, ii, 346) to observe ionisation during the combination of chlorine and nitric oxide is that their experimental procedure is unfavourable to easy measurement of the change. J. F. S.

Disappearance of Gas in the Electric Discharge. II. The Research Staff of the General Electric Company, Ltd., London (*Phil. Mag.*, 1921, [vi], **41**, 685—706; see A., 1920, ii, 730).—In the presence of incandescent tungsten, hydrogen disappears without the passage of the discharge, the gas adhering with-

out change to the surface of the glass, especially to the cooler parts. When the discharge passes, the rate of disappearance of hydrogen is not greatly altered, but there is simultaneous liberation of adsorbed gas by bombardment and appearance of water vapour. Carbon monoxide is converted in the discharge into dioxide, both gases adhering to the glass walls, from which they can be liberated by heating. Nitrogen disappears under discharge, but cannot be liberated again by baking the vessel; at the same time, the filament wastes and the walls are blackened Langmuir's nitride, WN_2, is probably formed, but part of the gas may be held to the walls by a covering layer of tungsten. Argon disappears with much blackening of the bulb, but may be liberated by baking together with hydrogen produced by bombardment of the glass. Mercury has not been proved to disappear; the discharge through the vapour liberates large quantities of gas from the glass, even after previous baking in a high vacuum. Phosphorus vapour rapidly disappears and is converted into red phosphorus deposited on the walls. The glow potential of phosphorus vapour is anomalous. Hydrogen, carbon monoxide, and nitrogen mixed with phosphorus vapour disappear with the phosphorus; a lower final pressure of gas may be attained with a given applied potential in the presence of phosphorus. Chemical action of the phosphorus is not considered probable; the deposited red phosphorus may cover the deposited gas and prevent its liberation by bombardment; at the same time, it provides a new surface for adsorption. J. R. P.

Solutions of Metals in Non-metallic Solvents. VI. The Conductivity of the Alkali Metals in Liquid Ammonia. CHARLES A. KRAUS (*J. Amer. Chem. Soc.*, 1921, **43**, 749—770. Compare A., 1907, ii, 935; 1908, ii, 486, 834, 835; 1914, ii, 520).—The conductivity of solutions of sodium, potassium, lithium, and mixtures of sodium and potassium in liquid ammonia at the boiling point of liquid ammonia have been determined. From a consideration of the results of the present work and that previously published (*loc. cit.*), it is shown that an ionic equilibrium exists in solutions of a metal in liquid ammonia, and that the negative carrier is identical for all metals, and exhibits abnormal conducting power in the case of the more concentrated solutions. It follows as a consequence that the conductivity curve for such solutions should exhibit a minimum. In keeping with experimental fact, it is shown that the conductivity curve for dilute solutions should correspond approximately with that of ordinary salts in liquid ammonia. In the more concentrated solutions, the conductivity curve should rise with increasing concentration owing to the increase in speed of the negative carrier. The conductivity curves of sodium, potassium, and lithium, as well as those of mixtures of sodium and potassium, are similar in form, but are displaced as regards the value of the conductivity. The difference in the conductivity of the more dilute solutions corresponds approximately with the difference in the conductivity of the positive ions of these metals. Solutions of metals in liquid ammonia appear to form the connecting link between metallic and electrolytic conductors. It has been definitely shown that the conduction process

is an ionic one and there is nothing to distinguish the more concentrated solutions from actual metallic substances. It may therefore be concluded that the process of conduction in the case of ordinary metals is effected by means of the same negative carrier. Since this carrier is negatively charged and has sub-atomic dimensions, it may be concluded that it is identical with the negative electron as it appears in radioactive and other phenomena.

J. F. S.

Abnormality of Strong Electrolytes. DAVID LEONARD CHAPMAN and HERBERT JOHN GEORGE (*Phil. Mag.*, 1921, [vi], **41**, 799—801).—In the calculations of Ghosh (T., 1918, **113**, 449, 627, 707, and 790), the number of ions having kinetic energies in excess of a given value has been obtained by an incorrect formula. When the correct expression is used the results are no longer in good agreement with experiment. J. R. P.

Electrical Properties and Peptisation of Colloids. GEORG VARGA (*Koll. Chem. Beihefte*, 1919, **11**, 3—33).—The electrical conductivity of stannic acid suspensions has been determined at 25° for a series of concentrations by shaking a definite quantity of stannic acid with potassium hydroxide and measuring the conductivity, then allowing the suspension to settle, and again determining the conductivity, the difference between the two values giving the conductivity of the suspension. The hydrogen-ion concentration of stannic acid suspensions has been determined by the indicator method in a Coehn apparatus as modified by Galecki (A., 1912, ii, 263). Conductivity values and hydrogen-ion concentrations were also made in suspensions which had been boiled for considerable periods. The migration of stannic acid suspensions has also been determined. It is shown theoretically that the quantity of electricity transported by the stannic acid particles may be calculated by the formula $E_{SnO_3}=K_m/K_s\times E_s.U_{SnO_3}/(U_k+U_{SnO_3})$ in which K_m is the conductivity of the micellæ, K_s that of the suspension or sol, U_k and U_{SnO_3} the velocities of the potassium and stannate ions respectively in cm./sec. under a potential drop of 1 volt/cm., and E_s and E_{SnO_3} the quantities of electricity carried by the suspension and the stannate ion respectively. The author develops a theory of peptisation, and a theoretical introduction to the paper is added by R. Zsigmondy. J. F. S.

The Electromotive Behaviour of Aluminium. II. A. SMITS and G. J. DE GRUIJTER (*Proc. K. Acad. Wetensch. Amsterdam*, 1921, **23**, 966—968. Compare A., 1920, ii, 579).—With the object of obtaining a clearer insight into the electromotive behaviour of aluminium and its alloys with mercury, the melting point composition diagram has been constructed, from which it is shown that no intermetallic compounds are formed between these metals. It is shown that, assuming Gibbs's paradox is applicable to the components of a mixed crystal phase present in dilute solution, the formula $E=-0{\cdot}058/\nu F.\log L_M/M_L^\nu-2{\cdot}8$ represents the experimental potential. It is to be expected that the potential of

aluminium in a solution of aluminium ions should become less negative by the addition of a little mercury, but the reverse is found to be the case, and this to a considerable degree. This indicates that mercury dissolved in aluminium is a catalyst for the internal transformations of aluminium. J. F. S.

The Current Produced when a Soldered Junction is Submitted to Pressure. M. POLÁNYI (*Zeitsch. physikal. Chem.*, 1921, **97**, 459—463).—A theoretical paper in which it is shown that if a conducting circuit is made of two pieces of different metal wires soldered together at each end, and one junction is submitted to a pressure, an *E.M.F.* will be set up. This conclusion is based on the assumption that material particles always travel with an electric current. It is shown that this *E.M.F.* may be readily determined in certain cases, and it will have a value of several centi-volts for moderate pressures. A measurement of this effect will naturally lead to a knowledge of the transport numbers of solid electrolytes and also to the ratio of the electronic conductivity to the material conductivity in poor conductors of electricity.

J. F. S.

The Alleged Uselessness of the Weston Normal Element. W. JAEGER and H. VON STEINWEHR (*Zeitsch. physikal. Chem.*, 1921, **97**, 319—329).—An answer to Cohen and Moesveld's assertion that the Weston element is metastable even at ordinary temperatures (A., 1920, ii, 581). It is shown that the Weston element containing 12·5% amalgam behaves exactly in the same way as the previously used element containing 14·3% amalgam, and that at ordinary temperatures both are absolutely normal in their behaviour. At temperatures below the transition point of 12·1° given by Cohen and Moesveld for the 12·5% amalgam, not a single element, out of sixty examined at the Reichsanstalt, exhibited any divergence. The divergence of the *E.M.F.* observed by Smith (*loc. cit.*) at 0° was due to the use of an amalgam which had been suddenly cooled in its preparation, and elements prepared with this material become quite normal immediately at ordinary temperatures. It is shown that the measurements on which Cohen and Moesveld base their assertion are not permissible, because the elements concerned were already above the "branching point" and had not been cooled below it, but nevertheless they exhibited values which were markedly divergent from the normal value. J. F. S.

The Hydrogenation of Quinhydrones. EINAR BIILMANN (*Ann. Chim.*, 1921, [ix], **15**, 109—157).—It is possible to prepare with aqueous solutions of quinhydrones reversible electrodes with very constant potential. Such electrodes may be used to determine hydrogen-ion concentration in a number of cases where the use of an ordinary hydrogen electrode is not possible. Such electrodes have been constructed with *p*-benzoquinone, toluquinone, and xyloquinone. The potentials of hydrogenation found in the three cases are, for *p*-benzoquinone 0·7044 volt at 18° and 0·6990 volt at 25°; for toluquinone 0·6507 volt at 18° and 0·6454 volt at 25°; and for

xyloquinone 0·6014 volt at 18° and 0·5960 volt at 25°. Thus the value $\pi_{18}-\pi_{25}$ is the same in each case, and, further, the variation in the potential due to the introduction of the first methyl group is less than that due to the introduction of the second methyl group. The heats of hydrogenation of the three quinones calculated from the hydrogenation potentials are, for *p*-benzoquinone U=42·8 cal.; for toluquinone U=40·1 cal., and for xyloquinone U=38·1 cal.

An electrode prepared from benzoquinone was found to be more convenient and rapid in rise than a hydrogen electrode in measuring the hydrogen-ion concentration of such solutions as those of the mineral acids. In addition, it could be used for such measurements with solutions of compounds containing ethylenic and acetylenic linkings such as solutions of acrylic, crotonic, fumaric, maleic, and phenylpropiolic acids; also with halogenated acids such as chloroacetic acid, and with an amino-acid of the type of glycine.

W. G.

The Measurement of Electrolytic Resistance Using Alternating Currents. H. F. HAWORTH (*Trans. Faraday Soc.*, 1921, **16**, 365—391).—When an alternating current is sent through a solution, and the electrical constants of the apparatus between the electrodes are determined, the cell appears as a capacity in series with a resistance. A special apparatus of the bridge type was designed for measuring the capacity and resistance of cells at constant temperature (±0·001°), and experiments were made to determine the variation of apparent resistance and capacity with the frequency *f* of the alternating current, using both plain and platinised platinum electrodes. Experiments with potassium chloride cells, using non-platinised electrodes, showed that the apparent resistance diminished with increasing frequency; with 0·1*N*-KCl the resistance $R=22\cdot24f^{-0\cdot20}$ at 25°, whilst with 0·025*N*-KCl, $R=42\cdot96f^{-0\cdot109}$. When platinised electrodes were used, the variation of resistance with frequency was much less, but the capacity of the cell was increased enormously. Comparative dilution experiments with both platinised and unplatinised electrodes showed that, in the former case, as the dilution increased the effect of variation of frequency became more pronounced, whereas with plain electrodes it diminished, until at high dilutions there is little to choose between the two forms of electrode. The effective capacity of the cell decreases with increasing dilution. A graphic method was devised by which, from observations of the apparent resistance at two different frequencies, using unplatinised electrodes, the true resistance of the cell can be found by extrapolating to infinite frequency. The value thus found agreed very nearly with the value obtained experimentally, using platinised electrodes at the same dilution, in the cases of potassium chloride, sodium, ferric, nickel, and cobalt chlorides, but with ammonium chloride the agreement was not so good.

The effect of platinising the electrodes is not considered to be due to an increase in area, but more probably to absorption of the normal gas film, which behaves as a leaky condenser, by the

"spongy" platinum, thus enormously increasing the capacity of the electrodes to the electrolyte, reducing the voltage across this dielectric per unit current and reducing the losses. Experiments using strong solutions and low resistance cells have shown, by various potentiometer measurements, that the resistance of an electrolyte is independent of the frequency, provided that the potential electrodes are put into an electrical backwater, that is, out of the main current stream. E. H. R.

Electrolysis of Water and a Oxy-hydrogen Gas Element. EMIL BAUR (*Helv. Chim. Acta*, 1921, **4**, 325—333).—With the object of storing seasonal water-power, the author has devised an apparatus by means of which fused aqueous sodium hydroxide is electrolysed, sheet-iron electrodes being employed. Only the hydrogen generated is stored and is used subsequently in conjunction with air in an element in which electric current is produced by the union of the hydrogen and oxygen in contact with fused sodium hydroxide, electrodes in the form of iron grids being used. T. H. P.

The Electrolysis of Solutions of Sodium Nitrite, using a Copper Anode. F. H. JEFFERY (*Trans. Faraday Soc.*, 1921, **16**, 453—457).—The electrolysis of solutions containing 6·9, 13·8, and 27·6 grams of sodium nitrite per 100 c.c. was studied, using a current of 0·16 ampere, with a copper anode, the arrangements of the electrolysis vessel being similar to those in the experiments with a silver anode (A., 1920, ii, 662). The copper went into solution, forming a dark yellowish-green anolyte, whilst a bluish-green solid was formed on the anode and some gas was evolved from this electrode. No copper was deposited on the cathode. The copper complex in the anolyte contained bivalent copper, since sodium hydroxide gave an immediate precipitate of cupric hydroxide, whilst ammonium thiocyanate gave no precipitate. By addition of potassium and lead nitrate to the anolyte and allowing to crystallise, well-formed black crystals of the compound $K_2Pb[Cu(NO_2)_6]$ were obtained, and from these, by means of potassium sulphate, dark olive-green crystals of $K_4[Cu(NO_2)_6]$ were prepared. These are regarded as salts of cupri-nitrous acid, $H_4[Cu(NO_2)_6]$. The gas evolved from the anode was pure nitric oxide. The solid deposited on the anode had the same composition, however the concentration of sodium nitrite was varied, and corresponded with the formula $Cu(NO_2)_2,CuO$. It is slowly hydrolysed by water. When the electrolysing current was increased to 0·35 ampere, copper was slowly deposited on the cathode at all concentrations of sodium nitrite. E. H. R.

Thermal Expansion of Liquids. W. HERZ (*Zeitsch. physikal. Chem.*, 1921, **97**, 376—381).—A theoretical paper in which the author has examined the nature of the constant a, contained in the formula, $V_0/V_t=(a\theta-T)/(a\theta-273)$, put forward by Thorpe and Rücker (T., 1884, **45**, 135) to represent the dependence of specific volume of liquids on the temperature. It is shown, by considering a large number of cases, that this formula represents the facts only to a

restricted degree. The constant a is in reality not constant, since it decreases with increasing temperature. In most series of analogous substances, a increases with the molecular or atomic weights respectively. With the exception of water, the value of a lies in all cases between 1·5 and 2·1. Water is exceptional, because of its anomalous density. The constant a enters into an equation representing the thermal expansion of liquids put forward by Oswald (A., 1912, ii, 230) and Davies (A., 1912, ii, 426) which has the form $\alpha=1/(a\theta-T)$. Here the coefficient of expansion can be calculated from the critical temperature. The coefficient of expansion is smaller the higher the critical temperature. J. F. S.

Specific Heat of Aqueous Salt Solutions. KARL JAUCH (*Zeitsch. Physik*, 1921, **4**, 441—447).—The specific heats of aqueous solutions of chloric and iodic acids, the chlorides of lithium, barium, aluminium, thorium, and mercury, the bromides of lithium, sodium, magnesium, cæsium, indium, and rubidium, the iodides of lithium and sodium, the fluorides of potassium and thallium, the nitrates of glucinum, aluminium, lanthanum, samarium, cæsium, and lead, and lithium chlorate and iodate have been determined at 18° in various concentrations generally lying between $0{\cdot}5M$ and $5{\cdot}0M$. The results are discussed in connexion with the specific volume and the ionisation. J. F. S.

Equation of Condition for Liquids. K. K. JÄRVINEN (*Zeitsch. physikal. Chem.*, 1921, **97**, 445—458).—A mathematical paper in which from the general form of the equations of condition for liquids, $p=p_k-p_a=fRT/v-a/v^u$, the author develops for monatomic substances the equation $p=p_k-p_a=fRT/v-p_a=kv^{1/3}/(v^{1/3}-b^{1/3})\times RT/v-a/v^{2\cdot5}$. This equation is applied particularly to the case of mercury and various physical constants evaluated from known data. These include the coefficient of compressibility, $1{\cdot}336\times10^{-6}$, the coefficient of expansion, $1{\cdot}807\times10^{-4}$, both values for 0°; at 400° the values become $5{\cdot}803\times10^{-6}$ and $1{\cdot}835\times10^{-4}$ respectively. A number of calculations are made for ethyl ether. J. F. S.

Thermodynamics of Mixtures. VI, VII, and VIII. MARIO BASTO WAGNER (*Zeitsch. physikal. Chem.*, 1921, **97**, 330—336, 337—342, 343—367. Compare this vol., ii, 162, 180, 301).—A series of mathematical papers in which the thermodynamic treatment of mixtures is further developed. In the present papers, the author develops a thermodynamical theory of mixtures, of any concentrations, in which no use is made of the Nernst theorem or of the hypotheses of Planck. The absolute entropy of mixtures is treated in the second paper, and the third paper deals with the conditions of reversibility, especially in the case of two component two phase purely physical systems. J. F. S.

Freezing Points of Binary Aqueous Solutions of Electrolytes. OSKAR KLEIN and OLOF SVANBERG (*Medd. K. Vetenskapsakad. Nobel-Inst.*, 1920, **4**, No. 1, 1—13).—The freezing points of solutions containing two salts were determined by Dernby's method

(*ibid.*, 1916, **3**, No. 18). No general law expressing the sign of the neutral salt action was found. In some cases the lowering of freezing point is smaller, in others greater, than the sum of the individual depressions. The salt action is positive with most electrolytes, with sulphates, nitrates, and alkali hydroxides the action is negative. The value of $K=\delta/c_1c_2$, where δ is the difference between the lowering for the solution and the calculated sum of the individual lowerings, c_1 and c_2, are the concentrations of the two salts, is used to express the salt action. In mixtures of halogen hydracids and haloids of alkali-metals K is positive and fairly constant. With salts of alkaline-earths, K is also positive but increases with concentration. J. R. P.

The Three-Temperature Rule. MAURICE PRUD'HOMME (*J. Chim. Phys.*, 1920, **18**, 359—361; *Ann. Chim.*, 1921, [ix], **15**, 212—220).—In previous papers (this vol., ii, 83, 84), the author has shown that $T_f(T_c-T_f)/T_1(T_c-T_1)=r$ and $T_c/(T_1+T_f)=r'$, in which T_c T_1 and T_f are respectively the absolute values of the critical, normal boiling, and freezing temperatures, and r and r' constants. Generally r and r' are very nearly equal. In certain cases, these two values are identical to the second place of decimals; this occurs with water, phosphine, arsenic trichloride, methyl bromide, methyl iodide, *m*-xylene, 1:3:5-trimethylbenzene, chloro-, bromo-, and iodo-benzene, titanium tetrachloride, and acetonitrile. For these cases, the two equations may be equated, and the expression $T_f(T_c-T_f)/T_1(T_c-T_1)=(T_1+T_f)/T_c$ obtained. This is developed into a cubic equation in T_1 of the form $T_1^3-(T_c-T_f)T_1^2-T_cT_fT_1+T_cT_f(T_c-T_f)=0$ which has the roots (T_c-T_f), $\sqrt{T_cT_f}$, and $-\sqrt{T_cT_f}$. It is shown that the observed value of T_1 only agrees with the root T_c-T_f when both sides of the identity above have the value unity. And the author deduces that for each substance there is a vapour tension at which $T_c=T_1+T_f$. J. F. S.

Some New Methods for the Determination of the Vapour Pressure of Salt Hydrates. ROBERT E. WILSON (*J. Amer. Chem. Soc.*, 1921, **43**, 704—725).—The methods used by previous investigators in the determination of the vapour pressure of salt hydrates are described in fair detail and their defects pointed out. The author advances reasons for choosing a new type of indirect method for determination of this quantity. The method consists in the establishment of equilibrium between the hydrates and a solution of water in *iso*amyl alcohol, followed by an estimation of the water content of the resulting mixture. Three new quantitative methods are described for estimating the water content of *iso*amyl alcohol solutions, (*a*) colorimetric comparison of standard cobalt chloride solutions; (*b*) determination of the conductivity of standard cobalt chloride solutions; (*c*) determination of the conductivity of saturated potassium thiocyanate solutions. The last-named method is the one preferred. Data are given on the colour and conductivity of cobalt chloride solutions in amyl alcohol as a function of the temperature and water content; approximate values are also given for the conductivity of a large number of other salts in

anhydrous and aqueous amyl alcohol. The solubility of water in *iso*amyl alcohol is found to be 9·77% at 25°. To establish the vapour pressure–water content curve for *iso*amyl alcohol solutions, it was necessary to determine with great accuracy the pressure of aqueous vapour of a few hydrated salts. This has been done for the pairs $CuSO_4,5H_2O \longrightarrow 3H_2O$; $BaCl_2,2H_2O \longrightarrow H_2O$; $Na_2HPO_4,12H_2O \longrightarrow 7H_2O$; $Na_2HAsO_4,7H_2O \longrightarrow 2H_2O$ and $Na_2SO_4,10H_2O \longrightarrow Na_2SO_4$, all at 25°. The method adopted consisted in placing the salts in a small balance inside a desiccator fitted with a fan and stirrer and containing sulphuric acid solution, the strength of which was varied until the concentration was found at which the salt neither gained nor lost weight. This method is found to be very satisfactory for salts which gain or lose water with fair rapidity. J. F. S.

Determination of the Vapour Pressure of Salt Hydrate by a Distribution-Conductivity Method. ARTHUR A. NOYES and LEON R. WESTBROOK (*J. Amer. Chem. Soc.*, 1921, **43**, 726—734. Compare Wilson, preceding abstract).—A detailed description of Wilson's distribution method for the determination of the vapour pressure of salt hydrates. The method consists in shaking the salt hydrate with anhydrous *iso*amyl alcohol, or *iso*amyl alcohol containing a known small quantity of water until equilibrium is set up and then analysing the alcoholic phase to determine its water content by saturating it with solid potassium thiocyanate and measuring the electrical conductivity of the mixture. The development of the method into a practically useful form involved the determination of the electrical conductivity of *iso*amyl alcohol solutions of known water content saturated with potassium thiocyanate and the determination of the water content in *iso*amyl alcohol solutions which had been brought into equilibrium with pairs of hydrates of accurately known vapour pressure. The conductivity of water–*iso*amyl alcohol mixtures saturated with potassium thiocyanate has been determined at 25° for water percentages between 0 and 3·016. The solubility of water in *iso*amyl alcohol is found to be 9·884% at 25°. This value is about 1% higher than that found by Wilson (*loc. cit.*), but since the vapour pressure–water content curve is very flat in this vicinity the difference between the two values is of little moment. A vapour pressure–composition diagram for water–*iso*amyl alcohol mixtures is constructed, which is probably typical for liquids of limited but considerable miscibility.
J. F. S.

The Vapour Pressures of Mixtures. ALFRED W. PORTER (*Trans. Faraday Society*, 1921, **16**, 336—345).—The fundamental relation between the vapour pressures of the constituents of a binary liquid mixture and the composition of the mixture is given by Duhem's differential equation

$$\mu_a \cdot (\partial \log \Pi_a)/(\partial \mu_a) = \mu_b (\partial \log \Pi_b)/(\partial \mu_b)$$

where μ_a and μ_b are the molar fractions of the components and Π_a and Π_b are the respective vapour pressures. A new thermodynamic proof of this theorem is given, assuming that the vapour mixture follows the perfect gas law, that is, that the partial pres-

sures of the components are additive. This equation was integrated by Margules, from whose solution it can be shown that $\pi_a = \Pi_a \mu_a e^{\beta(1-\mu_a)^2}$, where Π_a is the value of π_a when μ_a becomes unity. Similarly, $\pi_b = \Pi_b(1-\mu_a)e^{\beta\mu_a^2}$. The experimental results of Sameshima on the vapour pressures of mixtures of acetone and ethyl ether (A., 1918, ii, 429) agree very well with the figures calculated from these equations. The value of the constant β for these mixtures is 0·7414, and it increases slightly as the temperature is lowered. A diagram is given showing the different kinds of curve obtained, when relative vapour pressure is plotted against molar concentration in the liquid mixture, from the equation $\pi_a/\Pi_a = \mu_a e^{\beta(1-\mu_a)^2}$ for different values of β from $+3$ to -3. When $\beta=0$ the partial pressure curve is a straight line; for positive values of β it lies wholly above this line, and for negative values wholly below it. For $\beta=2$ there is a horizontal point of inflexion and for higher values there are two points, on either side of a maximum, for which the vapour pressure is the same. This is of importance in connexion with the equilibrium of partly miscible liquids. For mixtures of methyl alcohol and glycerol $\beta=1$; for acetone and oleic acid about 0·5; for ether and oleic acid $-0·2$. In the case of sulphuric acid–ethyl ether mixtures, an abnormal curve is obtained; for the lower part of the curve $\beta=-6$, but when the proportion of ether in the mixture becomes large the curve requires a positive value of β. In such cases as this, and only in such cases, it appears necessary to introduce a chemical hypothesis to explain the phenomena.

In the second part of the paper it is shown mathematically that the Duhem–Margules equations can be extended to systems of higher order than the binary. E. H. R.

Vapour Tension and Molecular Volume of Toluene–Benzene Mixtures. ALFRED SCHULZE (*Zeitsch. physikal. Chem.*, 1921, **97**, 417—425).—In a previous paper (A., 1919, ii, 390) the author describes a number of determinations of the vapour tension of mixtures of toluene and benzene. These results are now examined together with further data published for the first time in the present paper. The vapour tension curves of the mixtures at ordinary temperatures are concave toward the concentration axis, but at 60° become straight lines and remain so at 79·7° and 120·3°. The vapour tension isothermal shows that at ordinary temperatures toluene is fairly strongly associated, and this is in keeping with the volume change which occurs when the mixtures are prepared. An hypothesis of the volume dilation is developed on the basis of the theory of concentrated solutions and with the assumption that one component is bimolecular. The volume dilation curve has been constructed from calculations based on the molecular constitution of the mixtures and found to be in excellent agreement with the experimental curve. This indicates that the conclusions drawn from the vapour tension isothermal are in keeping with those drawn from other physical properties, and consequently furnishes a confirmation of the theory of concentrated solutions.

J. F. S.

Principles of New Methods Applicable to the Determination of Molecular Weights. CAMILLE MATIGNON (*Compt. rend.*, 1921, **172**, 1036—1038).—If in a system $A_{\text{liq.}} \rightleftharpoons B_{\text{gas}}+C_{\text{sol}}$, where C is insoluble in A, a weight π of a substance, having a molecular weight M and without physical or chemical action on B or C, is dissolved in 100 grams of A, then if the vapour tension of B, represented by p_b, is thereby diminished by an amount x,

$$x=Kp_b\pi/p_aM,$$

where K is a constant depending only on the nature of A. This principle is further developed for a bivariant system. W. G.

The Use of Enamelled Bombs in Calorimetry. C. MATIGNON and (MLLE) G. MARCHAL (*Compt. rend.*, 1921, **172**, 921—922).—Two instances are quoted where two enamelled calorimetric bombs of the Mahler type and of recent manufacture were attacked by the nitric acid, such as is always formed in the ordinary conditions of calorimetric work. To obviate this source of error, new bombs should be filled with N-nitric acid and submitted to its action for four or five hours before being used. W. G.

Modifications of the Adiabatic Calorimeter. W. SWIENTOSLAWSKI (*J. Amer. Chem. Soc.*, 1921, **43**, 875—876).—The author describes modifications of his adiabatic calorimeter (A., 1915, ii, 420), whereby the temperature of the jacket can be brought to 0·1° of that of the calorimeter in one and a half minutes after the reaction starts, and to within a few thousandths of a degree in five minutes. The heating and cooling of the jacket are effected by hot or cold water introduced from without by means of a current of air. J. F. S.

Heat of Combustion of Benzoic Acid, Naphthalene, and Sucrose. F. HENNING (*Zeitsch. physikal. Chem.*, 1921, **97**, 467—477).—A critical consideration of the data appearing in the literature on the heat of combustion of sucrose, benzoic acid, and naphthalene. It is shown that data put forward do not allow of any conclusions being drawn as to which of the above-named substances is most suited for normal determinations. The absolute values of the heat of combustion, determined by the different observers, fluctuate as much as 2·5% from the mean value. The ratio of the heats of combustion of these substances varies 2—3%, which indicates, probably, impure materials in some cases. After removing those results which appear for obvious reasons to be inaccurate, the author calculates the most probable values of the heat of combustion and finds the following values: benzoic acid, 6320 $\text{cal.}_{15°}$/gram (vacuum)=26444 joule/gram (vacuum); naphthalene, 9617 $\text{cal.}_{15°}$/gram (vacuum)=40239 joule/gram (vacuum) and sucrose 3949 $\text{cal.}_{15°}$/gram (vacuum)=16523 joule/gram (vacuum), from which the ratios: naphthalene/benzoic acid=1·5217 and sucrose/benzoic acid=0·6248 are obtained. The above figures are probably accurate to 1·5%. The author suggests that the determination of the water value of a calorimetric bomb should be made with all three substances, using the above values and the mean of the three values taken as the correct value. J. F. S.

Heats of Dilution and the Specific Heats of Dilute Solutions of Nitric Acid and of Hydroxides, Chlorides, and Nitrates of Lithium, Sodium, Potassium, and Cæsium. THEODORE W. RICHARDS and ALLAN WINTER ROWE (*J. Amer. Chem. Soc.*, 1921, **43**, 770—796).—The heats of dilution of nitric acid, of the hydroxides of lithium, sodium, and potassium, and of the chlorides and nitrates of lithium, sodium, potassium, and cæsium have been determined at about 16° and 20°. The values obtained are recorded in two long tables in joules and calories. Approximate values are obtained for rubidium compounds by extrapolation. Some of these heats of dilution are negative and some positive. Sodium hydroxide and nitric acid show change of sign on progressive dilution. Distinct relationship to the periodic system is shown in the progression of values, but some eccentricities, particularly in sodium salts, are manifest. From the results, the temperature coefficients of the heats of dilution were found and are recorded both in calories and joules. They are all positive. The specific heats of the various solutions are calculated, and it is shown how, by a simple method of plotting the heat capacity changes, all intermediate solutions may likewise be determined with considerable accuracy. The loss of heat capacity on dissolving salts in water is shown to be of the same order as the gain of heat capacity on neutralising acids by alkalis, in such a sense that the heat capacity is diminished by 50 to 100 mayers by such fraction of each gram ion as is formed from a gram-molecule in solutions containing $100H_2O$. Presumably the nature of the ion determines the exact magnitude of this loss of heat capacity. Heats of dilution and changes of heat capacity are shown to afford a possible partial clue to the extent of electrolytic dissociation. The temperature coefficient of the heat of neutralisation of solutions containing $100H_2O$ is shown to vary somewhat with the nature of the alkali and of the acid, and to average about 51 cal. or 213 joules per degree. Therefore the gain of heat capacity on neutralisation is 213 mayers. J. F. S.

Mass Effect in the Entropy of Solids and Gases. WENDELL M. LATIMER (*J. Amer. Chem. Soc.*, 1921, **43**, 818—826).—A theoretical paper in which it is postulated that there is a certain limiting value of the constraints in a solid below which the effect of the constraints on the entropy of the solid is constant. On this basis, the entropy of solids in which this condition is fulfilled is the sum of the entropies of the elements in the solid. The entropy of the elements in such a solid is given by the equation, $S_{298}=3/2R \log_e \text{at. wt.}-0{\cdot}94$. The entropy of all compounds on which data are available, 18 in number, is found to agree with the equation with an average variation of 0·7 entropy unit. The one condition is that the Kopp's law constant for the elements in the compound shall have reached approximately the value 6. The data on 10 diatomic gases are considered in connexion with the equation $S_{298}=3/2R \log_e \text{mol. wt.}+R/2 \log_e \text{at. wt.}'+R/2 \log_e \text{at. wt.}''+30{\cdot}22$. With the possible exception of iodine, the agreement is within the limits of experimental error. J. F. S.

Principle of Similitude and the Entropy of Polyatomic Gases. RICHARD C. TOLMAN (*J. Amer. Chem. Soc.*, 1921, **43**, 866—875).—A theoretical paper in which the theory of similitude or relativity of size is considered by a somewhat simpler method than that previously adopted (A., 1920, ii, 468). The author derives equations connecting the entropy of a perfect gas composed of rigid diatomic or polyatomic molecules, with temperature, pressure, molecular weight, and the moments of inertia of the molecule. These equations are compared with the equations of Sackur, Tetrode, Schames, and Latimer and also with the available experimental data. J. F. S.

Molecular State of Water Vapour. ALAN W. C. MENZIES (*J. Amer. Chem. Soc.*, 1921, **43**, 851—857).—The density of saturated water vapour has been recalculated by means of the Clausius-Clapeyron equation for various temperatures, using modern data for the several factors involved. It is shown that the density does not become less than the ideal value below 30°, and that there is therefore no foundation for the hypothesis of spontaneous ionisation. The excess density at 100° computed from Regnault's data is about 100% too large. The numerous and remarkably concordant independent results of Perman (*Proc. Roy. Soc.*, 1903, **72**, 72) and of Krauskopf (*J. phys. Chem.*, 1907, ii, 318) for the vapour pressure of water at about 73° obtained by the gas current saturation method are shown to lead to a vapour density for saturated water vapour at that temperature which is less than 0·1% higher than the ideal value, whilst the value from the Clapeyron equation is 0·9% higher. This discrepancy merits further investigation. If D. Berthelot's equation of state is applied to the mean of these two results for 73°, the numerical basis remaining, from which to postulate polymerisation of water vapour at this temperature, is precisely zero. J. F. S.

Applicability of Mendeléev's Rule in the Case of Benzene and its Halogen-substitution Products. W. HERZ and JULIUS MEYER (*Zeitsch. physikal. Chem.*, 1921, **97**, 381—387).—Making use of the experimental density determinations of benzene and the halogen-substituted benzenes and mixtures of these substances, published previously by Meyer and Mylius (A., 1920, ii, 590) and Herz (A., 1914, ii, 425), the authors have tested the applicability of the Mendeléev rule, $D_t = D_0(1-Kt)$, to these substances. The calculations show that this rule represents the experimental facts equally for normal and abnormal liquids within the limits of the experimental error. The value of K fluctuates irregularly about a mean value, this being probably due to experimental error in the determinations which, since the calculation of K is made from differences, shows itself in an exaggerated manner. From this it follows that the percentage error is of the same order both for normal and abnormal liquids, and the Mendeléev equation cannot be used to differentiate between the two types of liquids. It is possible that a differentiation could be made if the accuracy of the density determinations were increased 10—100 times. It is probable that

the *K* value of mixtures of normal liquids can be calculated from that of the components of the mixture by the additive mixture rule. J. F. S.

Viscosimeter. ROBERT FISCHER (*Zeitsch. angew. Chem.*, 1921, **34**, 153—154).—Certain modifications are suggested in a falling-sphere viscosimeter described previously by the author (*Chem. Zeit.*, 1920, **44**, 622) for use with dark coloured liquids. The tube is widened so that the tubulus for the thermometer does not interfere with the descent of the ball, and the apparatus is standardised with different sized balls, so that a more equal rate of fall is obtained with liquids of high and low viscosities. In dealing with aqueous solutions, the electrical contacts at the bottom of the tube may be covered with a layer of carbon tetrachloride before the solution is introduced. W. P. S.

Viscosity and Flocculation of Coarse Suspensions. HANS EGNÉR (*Medd. K. Vetenskapsakad. Nobel-Inst.*, 1920, **4**, No. 4, 1—25).—The viscosity formula of Arrhenius (A., 1917, ii, 130) does not hold for suspensions of China clay and infusorial earth. It was not possible to test its validity for graphite. The empirical formula of Bingham and Durham (A., 1911, ii, 968) agrees in some cases, but not in others. The effect of electrolytes on the state of coarse suspensions is very marked. Kations flocculate, and increase the viscosity and sedimentation height. Anions act in the opposite way. The magnitude of the flocculating power generally follows the valency rule, but hydroxide ions often act irregularly. The properties of suspensions are very similar to those of suspension colloids. J. R. P.

Influence of some Compounds on the Viscosity of Solutions of Dextrose in Water. SVETOZARA VARIĆAK (*Rev. Chim.*, 1921, **1**, 57—71).—The author records a set of measurements of the coefficient of viscosity, at temperatures between 5° and 40°, of solutions in water of hydrochloric acid, potassium hydroxide, tartaric acid, acetamide, and dextrose, and for mixtures of solutions of dextrose with solutions of each of the other four substances, the concentrations ranging from one to one-tenth gram-molecule of each solute per litre. In all cases the general tendency is for the viscosity to decrease with rising temperature, but, in the neighbourhood of 25°, there is usually a fairly abrupt change in the direction of the viscosity–temperature curve. Thus the viscosities of mixtures of solutions of acetamide and dextrose decrease rapidly with rising temperature from 5° to 25°, but remain nearly constant from 25° to 40°. In most other instances, the fall of viscosity from 5° to 25° is relatively slight, but a rapid fall takes place between 25° and 40°, the viscosities at this temperature for corresponding concentrations being in all cases of about the same magnitude. C. K. I.

Sorption of Iodine by Carbon. JAMES BRIERLEY FIRTH (*Trans. Faraday Soc.*, 1921, **16**, 434—452).—The sorption of iodine by different forms of carbon from solution in benzene and chloroform

respectively has been studied over periods of time extending to five years. The forms of carbon used were lampblack, sugar-carbon, blood charcoal, animal charcoal, and coconut charcoal both from the fruit and the shell, definite weights of which, after suitable heating, were shaken in a thermostat at 25° with a decinormal solution of iodine in the solvent. From the results obtained, the constants β and P are calculated in the formula $x/m = \beta(a - x/v)1/P$, where x is the amount of iodine sorbed by m grams of carbon, and a is the total iodine originally present. Graphically, the results of the experiments are shown by plotting $\log x/m$ against $\log (a - x)$. Generally, a rapid condensation of the iodine by the charcoal takes place in the first few minutes, and is followed by a much slower sorption continuing for months or years. The first condensation is attributed to true adsorption, the second to a slow absorption. The amount of sorption varies from about 90% of the total iodine present in the case of blood charcoal, using chloroform as solvent, to less than 3% with powdered coconut fruit charcoal. The difference is not to be attributed to difference in surface area, but to a specific difference in the form and action of the carbon in the different cases. The amount of sorption is always greater from chloroform than from benzene, in which iodine has a greater solubility. During the second absorption phase the concentration of the iodine in the solvent diminishes to a certain minimum value, after which the rate of change of concentration, whatever the mass of sorbing solid present, is so slow that the concentration appears constant. The initial adsorption velocity is greater the smaller the size of carbon particles, whilst the presence of water in the carbon diminishes its activity. E. H. R.

The Estimation of the Adsorbing Power of Charcoal. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 630—656).—In order to determine whether the adsorptive power of charcoal of any particular variety for materials in general can be deduced from the adsorptive power for a selected material, experiments were carried out with various kinds of charcoal, iodine, phenol, mercuric chloride, mercuric cyanide, arsenic trioxide, various colouring materials and several alkaloids being employed as materials to be adsorbed. The charcoals selected were norit (water 11·8%, ash 5·7%), bactanate (water 26·3%, ash 7·8%), blood charcoal (water 30%, ash 4·8%), vegetable carbon (water 25·5%, ash, 4·5%), and medicinal carbon (water 30·6%, ash 6·5%), the last three being Merck's preparations. The adsorptive power of each of these varied considerably, but with all the materials tested the order was practically the same, namely, blood charcoal > vegetable carbon = medicinal carbon > bactanate > norit. These results confirm Freundlich's rule that the order in which materials are adsorbed is almost independent of the nature of the solid phase. The quantities adsorbed were only slightly affected by previous treatment of the charcoal with water or acid.

The quantity of iodine adsorbed per gram of charcoal was in the case of norit independent of the end concentration, but diminished with this for the other charcoals, although in no case was the ad-

sorption isotherm $x/m=ac^{1/n}$ found to hold. With almost all the other materials this equation was found to govern the quantities adsorbed, the constant a being taken as an index of the adsorptive power. As a practical method for testing the adsorptive powers of any given charcoal, the determination of the amounts of mercuric cyanide or phenol adsorbed by 1 gram from 100 c.c. of $N/10$-solution is recommended, the result being taken in conjunction with the figures given in the paper. S. I. L.

Critical Study of the Capillary Rise Method for Determining Surface Tension, with Data for Water, Benzene, Toluene, Chloroform, Carbon Tetrachloride, Ether, and Dimethylaniline. II. THEODORE W. RICHARDS and EMMETT K. CARVER (*J. Amer. Chem. Soc.*, 1921, **43**, 827—847. Compare A., 1915, ii, 522).—It is shown that the supposed finite contact angle (reputed to be the weakest point in the capillary rise method) does not exist with the liquids studied in the present work if the glass is properly cleaned and if evaporation of the liquid is prevented. The correction for the capillary rise in the wide tube calculated by Rayleigh and Laplace has been experimentally verified. A preliminary experimental curve for the capillary rise in tubes that are not wide enough to come under these mathematical equations has been obtained. This curve fits smoothly between the theoretical curve for very wide tubes and the theoretical curve for very narrow tubes. It has been shown that the method of calibrating tubes by weighing a mercury thread is not affected to an important extent by a film of air between the mercury and the glass, except perhaps in very fine capillaries. The disturbing effect of ellipticity in the cross section of the capillary is indicated. The difference between capillary rise in air and in a vacuum has been determined for six liquids. In most cases the effect on the surface tension is less than 0·5%. The surface tensions of water, 72·73; benzene 28·88; toluene 28·43; ether 16·96; chloroform 27·14; carbon tetrachloride 26·77; and dimethylaniline 36·56 have been measured in the presence of air. Removal of air increases the surface tension as follows: water +0·02; benzene +0·14; chloroform +0·10; carbon tetrachloride +0·18; ether +0·05; dimethylaniline +0·10. J. F. S.

Kinetic Theory of Osmotic Pressure. KARL F. HERZFELD (*Ann. Physik*, 1921, **64**, 646—660. Compare Jäger, A., 1913, ii, 762).—A theoretical paper in which an attempt is made to ascertain the mechanism of the process which drives a solvent through a semi-permeable membrane into a solution when both are exposed to the same external pressure. The author first considers how the external pressure arises in a pure liquid and then applies the results thus obtained to solutions in which there is no force of attraction between the solvent and the dissolved substance. It is shown that the presence of such an attractive force would not change the osmotic pressure in any sense. When the force of attraction is sufficiently large, the kinetic energy of the dissolved substance acts on the

capillary layer of the solvent instead of on the free surface. It is this pressure which brings about the movement of the surface and thereby the penetration of the solvent through the semi-permeable membrane. The force of attraction causes an increase in the internal pressure of the solution, but this is not in agreement with Tammann's results, as is to be expected from the measurements of the heat of hydration. J. F. S.

Solubility of Naphthalene in Aqueous Solutions of Alcohols and Fatty Acids. JOHANNE CHRISTIANSEN and SVANTE ARRHENIUS (*Med. K. Vetenskapsakad. Nobel-Inst.*, 1920, **4**, No. 2, 1—25).—The object of the investigation was to find a connexion between the ballograms (A., 1913, ii, 97, 177; 1916, ii, 75; 1917, ii, 404) of aqueous solutions of alcohols and fatty acids and other properties of the solutions. The concentration of solvent, alcohol or fatty acid, which exactly dissolves a given amount of naphthalene was determined. The solubility was found to increase as the nth power of the concentration of the solvent in its mixture with water. The value of n is nearly independent of temperature between 0° and 25° and lies between 2 and 4 for different solvents. Acetic acid behaves irregularly, as its value of n changes from 3 below 50 mol.% to 4 above this concentration, which probably indicates a hydrate of the composition $CH_3 \cdot CO_2H,H_2O$ if enough water is present. The solubility curves converge towards the origin, which indicates that the solubility of naphthalene in pure water is practically zero. J. R. P.

Existence of Hydrates in Aqueous Solutions. A. SMITS, L. VAN D. LANDE, and P. BOUMAN (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 969—974).—With the object of finding evidence in favour of the existence of hydrates in aqueous solution, the authors have examined the specific gravity, surface tension, and refraction of solutions of hydrated salts at constant temperature, but these results furnish no evidence in support of the existence of hydrates. In the case of viscosity measurements, however, the authors find support for the view that hydrates exist in solution. The viscosity of ferric chloride solutions has been examined at 40°. This temperature was chosen because it lies very near to the melting points of $FeCl_3,12H_2O$ and $FeCl_3,7H_2O$, and at this temperature the hydrates, if they exist at all, would not be so much dissociated as would be the case at higher temperatures. The viscosity curve is found to rise steadily until the composition has nearly reached that of $FeCl_3,12H_2O$, where a maximum is reached, it then falls until the composition has passed that of $FeCl_3,12H_2O$, and then rises rapidly. This peculiar shape is explained in such a way as to point to the existence of the hydrate in solution. Similar experiments are made in the system H_2O-SO_3, and here a similar curve is obtained at 15° for the hydrate H_2SO_4,H_2O; when the same mixtures are examined at 40° and 60° similar but very much less pronounced curves are obtained, which point to the dissociation of the hydrate at these temperatures. J. F. S.

The Existence of Compounds in Liquid Mixtures. W. P. Jorissen (*Rec. trav. chim.*, 1921, **40**, 281—284).—The results of Smits, van der Lande, and Bouman (preceding abstract) on the presence of hydrates in aqueous solution as indicated by viscosity measurements on aqueous solutions of ferric chloride and of sulphuric acid and those of other workers on the same subject (compare Kremann and Ehrlich, *Sitzungsber K. Akad. Wiss. Wien, math.-naturwiss*, 1907, **116**, II*b*, 789; Dunstan and Wilson, T., 1907, **91**, 83; 1908, **93**, 2179) are discussed as part of the more general question of the existence of compounds in liquid mixtures. W. G.

The Saturated Solutions of Two or several Substances. Application of Le Chatelier's Law. C. Raveau (*Compt. rend.*, 1921, **172**, 1099—1102).—The author discusses the law of reciprocity and considers that a careful revision will result in the correction of certain data, with reference to the solution of salts in the presence of one another, which are at present in contradiction with this law. W. G.

Surface Forces with Hetero-polar Crystal Lattices. Adsorption of Lead Isotopes by Colloidal Silver Haloids. K. Fajans and K. von Beckerath (*Zeitsch. physikal. Chem.*, 1921, **97**, 478—502).—The type of adsorption, which consists in the accumulation of dehydrated solution ions on the oppositely charged ions of a crystal lattice, is theoretically considered. It is shown from colloid chemical experiments that Paneth's adsorption rule for the adsorption of radio-elements in all probability is true for the present type of adsorption (A., 1914, ii, 19). The adsorption of thorium-*B* by silver bromide sols, and by silver chloride and iodide, has been experimentally determined, as has also that of ordinary lead by negative silver bromide sols. The results show that silver haloid sols, which have become positively charged by the adsorption of silver ions, do not adsorb thorium-*B* to a measurable extent. Negatively charged silver haloid sols adsorb thorium-*B*, and the amount of adsorption increases with increasing excess of the halogen ion. Negatively charged silver bromide sols adsorb quantities of lead up to a concentration $0{\cdot}25 \times 10^{-3}$ millimols./litre $(Pb(NO_3)_2$ in strict proportion to the lead concentration. At higher concentrations, the adsorbed amount falls short of the strict proportionality. J. F. S.

A Thermo-electrical Differential Method for the Determination of Transition Points of Metals at Comparatively Low Temperatures. A. Smits and J. Spuyman (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 977—979. Compare this vol., ii, 246).—Making use of the method previously described and of a still more sensitive modification of the method, an attempt was made to ascertain whether copper shows a transition point at about 70°, but although every possible means were taken to bring about transition, no indication is given of such a point by either method. J. F. S.

Formation and Stability of Modifications of Polymorphous Substances Below their Transition Temperature. R. BRAUNS (*Centr. Min.*, 1921, 225—229).—The metastable forms of sulphur, including monoclinic prismatic sulphur, which form when molten sulphur crystallises, can be kept unchanged for years between a microscope slide and cover-glass. Other metastable crystals which can be obtained and preserved are the yellow form of mercuric iodide which is stable only for a few hours, and the rhombohedral form of potassium nitrate, which may be kept for years. These substances when crystallising appear to follow Ostwald's step rule, that when a change of form occurs, the form appearing is that which is accompanied by the smallest loss of free energy. Doubly-refracting cubic crystals of boracite found in salt deposits indicate that the boracite first crystallised in the cubic form far below its transition point, 265°. Mügge's conclusion that the temperature rose locally to so high a point as this during crystallisation is not justified; more probably this substance also follows Ostwald's rule, and separates first in the metastable cubic form. E. H. R.

Thermo-kinetic Explanation for the Reciprocal Attraction of Colloidal Particles (A Possibility of Explaining Gravitation). ROBERT FRICKE (*Zeitsch. physikal. Chem.*, 1921, **97**, 464—466).—A correction and an extension of the author's previous paper (A., 1920, ii, 740). J. F. S.

The Soaps as Protective Colloids for Colloidal Gold. THOMAS IREDALE (T., 1921, **119**, 625—634).

Colloid Chemical Aspects of the Theory of Indicators. G. WIEGNER (*Mitt. Lebensm. Hyg.*, 1920, **11**, 216—227).—Many indicators are known to possess colloidal properties, being usually negatively charged suspensoids of which the degree of dispersion depends on the hydrogen-ion concentration. Congorubin in acid solution forms larger particles than in alkaline solution, and conforms with Ostwald's rule that increase in the size of the particles shifts the colour towards the blue end of the spectrum. Salts tend to give the blue colour, the effect increasing with the valency of the kation, in agreement with Schulze's rule. With barium hydroxide the colour remains blue, since the influence of the bivalent positive ion is greater than that of the univalent negative ion. Emulsoids such as casein, gelatin, etc., exert a protective action similar to that on colloidal gold, which then behaves as a synthetic indicator. The "protein errors" of indicators and their sensitisation by salts admit of explanation from this point of view. CHEMICAL ABSTRACTS.

Phthalate Buffers—Some Incompatibilities. HARPER F. ZOLLER (*J. Amer. Chem. Soc.*, 1921, **43**, 914—916).—When a 0·1% solution of pure crystal-violet (hexamethyltriaminotriphenylmethane chloride) was added to a set of Clark and Lubs buffer mixtures throughout the range P_H 1·0 to 10·0 precipitation was found to occur in the zone P_H 2·2 to 4·4, and the amount of precipitate settling out seemed to bear a direct relation to the amount of dissociated free phthalic acid present. This did not occur when

buffer solutions over a similar range were prepared from acetic, citric, tartaric, or propionic acids. The phenomenon is due to the formation of an additive compound of phthalic acid with the triphenylmethane dye.

Impure lactalbumin in dilute concentration (0·01—0·001%) does not coagulate or flocculate at 60° in either citrate or acetate buffers, but it does in phthalate buffers over the range P_H 2·4 to 5·0. W. G.

The Influence of Salts on Chemical Equilibria in Solution. J. N. BRÖNSTED (T., 1921, **119**, 574—592).

Equilibria in Condensed Systems. ALFRED SCHULZE (*Zeitsch. physikal. Chem.*, 1921, **97**, 388—416).—Vapour pressure measurements of mixtures of ethyl ether–benzene, benzene–chloroform, and acetone–ethyl ether, of various compositions, made at a series of temperatures show in the first two cases that the components enter into chemical combination in the molecular ratio 1 : 1, and these compounds exist in a dissociated condition in the mixtures. The measurements for mixtures of ethyl ether–acetone show that acetone is a complex liquid. Calculation shows that at 20° it is bimolecular, whilst at 0° the molecule is very much more complex. The molecular constitution of the above-named mixtures has been calculated by the aid of the law of mass action, and it is shown that from a knowledge of this composition the other physical properties of the mixtures may be calculated from the corresponding properties of the components. This has been done for the specific heat and the molecular refraction, and the calculated values have been compared with the experimental values. A very good agreement between the two sets of values is found J. F. S.

The Pressure Variation of the Equilibrium Constant in Dilute Solution. A. M. WILLIAMS (*Trans. Faraday Soc.*, 1921, **16**, 458—463).—The expression obtained by Planck for the variation of the equilibrium constant of a reaction in dilute solution with pressure is $\partial \log K/\partial P = V_1 - V_2/RT$, where K is calculated for concentrations which are molar fractions of the total number of mols. present, including the solvent, and $V_1 - V_2$ denotes the volume change during the reaction. Rice (*Trans. Faraday Soc.*, 1917, **12**, 318) obtained a similar expression, but his K referred to volume concentrations. An attempt to explain the discrepancy was made by Mazzucchelli (A., 1920, ii, 17), but the explanation offered by him is now shown to be untenable. It is shown that the discrepancy is due to the different interpretations put upon the term $(V_1 - V_2)$ by Rice. Denoting Rice's constant by K', it is shown that $\partial \log K'/\partial P = \partial \log K/\partial P - \Sigma\lambda\beta$, where β is the compressibility of the fluid and $\Sigma\lambda$ is the change in the number of molecules involved in the reaction. An independent proof of the theorem from first principles is also presented. E. H. R.

Theory of Chemical Affinity from the Point of View of Polar Dissociation and the Law of Mass Action. D. REICHINSTEIN (*Zeitsch. physikal. Chem.*, 1921, **97**, 257—303).—The normal potentials of the electrodes $Te|Te_2''$ and $Te|Te^{\cdot\cdot\cdot\cdot}$ have been

experimentally determined at the ordinary temperature. From data obtained the following constants have been calculated: ${}_0\epsilon_{hk}\mathrm{Te} \leftarrow \mathrm{Te}^{\cdot\cdot\cdot\cdot} = +0\cdot558$ volt and ${}_0\epsilon_{ha}\mathrm{Te} \rightarrow \mathrm{Te}_2'' = -0\cdot827$ volt. The above values are used to calculate the *E.M.F.* of the element $\mathrm{Te}|\mathrm{Te}^{\cdot\cdot\cdot\cdot}||\mathrm{Te}_2''|\mathrm{Te}$ and the value ${}_a\epsilon^0{}_k = 1\cdot385$ obtained which is termed shortly the polarity potential. The polar solubility product of the second order is given by $\lambda = (\mathrm{Te}^{\cdot\cdot\cdot\cdot})(\mathrm{Te}_2'')^2 = 6\cdot2 \times 10^{-97}$ and the combination constant $K_{20} = (\mathrm{Te}^{\cdot\cdot\cdot\cdot})(\mathrm{OH}')^6/(\mathrm{TeO}'') = 2 \times 10^{-47}$. The polar solubility product of the third order

$$\lambda_3 = (\mathrm{TeO}_3'')(\mathrm{Te}_2'')^2(\mathrm{H}^{\cdot})^6 = \lambda.\lambda_{\mathrm{H_2O}}/K_{20} = 3\cdot4 \times 10^{-135}.$$

The theory of chemical affinity is based on the following foundations. First, the total affinity of a chemical element, that is, the sum of its positive and negative affinities, has nothing to do with its position in the electrolytic potential series, and secondly, the polarity potential of a chemical element is a direct measure of its total affinity, and this is therefore a function of its polar solubility product. The following rules concerning the relationships of the normal potentials are deduced from experimental work. When the value of ${}_0\epsilon_{kh}$ is known for a given chemical element, the value of ${}_0\epsilon_{ha}$ will be found to lie in the direction of the less noble elements and vice versa. The author makes the assumption that the chemical elements, which occupy the same sub-group of the periodic system, have the same value for their polar solubility products of the first order. When the electronic dissociation of an element M_2 is considered in connexion with the polar dissociation thus: $M_2 \rightleftharpoons M^{\cdot} + M'$; $M' \rightleftharpoons M + ⊖$, the chemical elements may be completely characterised by the three values λ, δ, and μ. These values are $\lambda = (M^{\cdot}) \times (M')$, $\delta = (\mathrm{M}).(⊕)/M'$, and $\mu = M.(⊖)$. The positive, negative, and total affinity of a chemical element can be quantitatively represented by these three quantities. J. F. S.

An Apparatus for Registering Variations of a Gaseous Mass with Time. A. A. GUNTZ (*Compt. rend.*, 1921, **172**, 918—920).—The apparatus which is figured and described consists essentially of a reaction vessel containing the gas the variations in volume of which is to be observed (for example in the reduction of an oxide by hydrogen), connected to a volumeter, having a nickel-chrome wire passing along its axis. Variations in volume are indicated by variations in the resistance of this wire as more or less of its length is free from the mercury. W. G.

Kinetics of the Decomposition of Hydrogen Peroxide. FR. BÜRKI and FR. SCHAAF (*Helv. Chim. Acta*, 1921, **4**, 418—425).—Investigation of the velocity of decomposition of hydrogen peroxide in alkaline solution under different conditions shows that this reaction is of the first order. The velocity of the reaction is dependent on the concentration of the base, but independent of its nature, and appears to be conditioned solely by the concentration of the hydroxyl ion. T. H. P.

The Speed of Reaction of Metallic Magnesium in Aqueous Solutions. ANT. VYSKOCIL (*Chem. Listy*, 1920, **14**, 121—123, 142—145, 166—171, 189—191).—On dissolving magnesium in

aqueous solutions of ammonium or neutral metallic salts, the water is first decomposed, a process which is catalysed by anions, particularly chloridion; thereafter the velocity of reaction depends largely on the chemical character of the solution. The Nernst-Brunner equation is inapplicable. The views advanced by Kistiakowsky (A., 1910, ii, 258) are upheld. Metallic magnesium can be rendered temporarily passive for certain reactions.

CHEMICAL ABSTRACTS.

Some Physico-chemical Problems connected with the Stability of Explosives. CYRIL NORMAN HINSHELWOOD (T., 1921, **119**, 721—734).

The General Study of Catalysis. MARCEL GUICHARD (*Bull. Soc. chim.*, 1921, [iv], **29**, 212—214).—The author indicates lines of research on catalysis in heterogeneous media, which are desirable in order that information may be obtained as to the mechanism of the action.

W. G.

Catalytic Action and Micellar Magnitude (Degree of Dispersion). ANTONIO MADINAVEITIA and FERNANDO DIÁZ AGUIRRECHE (*Anal. Fís. Quím.*, 1921, **19**, 124—135).—The authors have studied the relation between catalytic power and degree of dispersion in the rate of decomposition of hydrogen peroxide by colloidal gold solutions. By addition of suitable quantities of calcium chloride solution, gradual coagulation was effected as shown by colour changes in the metallic sol. Catalytic power was found to increase to a maximum, followed by a decline. The maximum catalytic power was observed when the gold sol was violet in colour. A similar result was obtained using dilute sulphuric acid as coagulant. The fact that catalytic power may sometimes increase with increasing micellar magnitude might be inferred from the fact that metallic ions on the one hand and macroscopic fragments of metal on the other possess little or no catalytic activity. An initial depression in catalytic power observed in these experiments is referred to the saturation of the liquid with oxygen in the early stages of the reaction. After previously saturating with oxygen, the initial value of K was lower and remained steady.

G. W. R.

Variations in the Catalytic Power of Colloidal Systems. ANTONIO DE GREGORIO ROCASOLANO (*Anal. Fís. Quím.*, 1921, **19**, 114—124. Compare this vol., ii, 251).—The ageing of colloidal systems has been studied in the variations of their catalytic power. The decomposition of hydrogen peroxide was followed, using as catalyst platinum electrosols of different ages and of different concentrations. In all cases the catalytic power, expressed by the constant K for the unimolecular reaction, showed an initial increase followed by a gradual decrease. Similar results were obtained with palladium sols. The initial increase of catalytic power with age was also shown in the case of the inversion of sucrose by invertase. The catalytic power of metallic sols is supposed to reside in the metal-oxygen complex and the initial increase in activity is attributed to an increase of oxygen concentration in the

disperse phase. With progressive ageing, the degree of dispersion diminishes and the catalytic power passes through a maximum and declines. Certain indications of periodicity in the decline of catalytic power were obtained. G. W. R.

Catalysis. XII. Some Induced Reactions and their Mechanism. NIL RATAN DHAR (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 1074—1079. Compare this vol., ii, 36—37).—A number of oxidations which are not readily brought about by oxygen directly, but are accelerated by the addition of a reducing agent which is easily oxidised by free oxygen, are described and discussed. Of these the oxidation of sodium arsenite by oxygen in the presence of sodium sulphite is an example. In this case sodium arsenite is not appreciably oxidised by oxygen, but sodium sulphite is; adding sodium sulphite to the arsenite accelerates the oxidation of the arsenite, but at the same time the oxidation of the sulphite is retarded. It is found in all cases that the substance, in which the oxidation is induced, acts as a negative catalyst towards the substance which induces the oxidation. To explain this action, the author assumes that a complex of the two oxidisable substances must be formed and that of this complex the part composed of the less oxidisable substance is more easily oxidised. J. F. S.

Catalytic Oxidation of Ferrous Salts in Acid Solutions. RICHARD THOMAS and EDWARD THOMAS WILLIAMS (T., 1921, **119**, 749—758).

Certain Catalytic Reactions. A. MAILHE (*Caoutchouc et Guttapercha*, 1920, **17**, 10584—10585; from *Chem. Zentr.*, 1921, i, 717).—Many syntheses effected by catalytic means are reversed at higher temperatures. The union of sulphur dioxide and oxygen which takes place readily at 400° in the presence of platinum black takes place more slowly at 500° on account of incipient reversal. *cyclo*Hexane, formed from benzene and hydrogen at 180° in the presence of nickel, decomposes again at 300°, forming benzene and hydrogen. Aldehydes and ketones give primary and secondary alcohols with hydrogen at 150—180° in the presence of nickel: these decompose again at 250° with the formation of aldehydes or ketones and hydrogen. The formation of amines from nitriles and hydrogen and the formation of nitriles from acids and ammonia are similarly reversible. Phenol and ethyl alcohol, in the presence of thorium oxide at 400°, give phenetole; at 460°, in presence of steam, the phenetole decomposes into phenol and ethyl alcohol.

[With DE GODON].—A mixture of aniline and methyl alcohol gives, at 380—400° in the presence of aluminium and thorium oxides, dimethylaniline, which at 460—480°, in the presence of thorium oxide and steam, gives aniline and methyl alcohol. G. W. R.

A Catalytic Method of Hydrogenation. JEAN NIVIÈRE (*Bull. Soc. chim.*, 1921, [iv], **29**, 217—219).—The material to be hydrogenated is dissolved in a suitable solvent in a stout-walled bottle,

a small amount of a solution of palladium chloride or platinum chloride is added to act as a catalyst, and then the calculated amount of calcium hydride is added gradually, the flask being stoppered and well shaken. This method was successfully used for the reduction of benzaldehyde, nitrobenzene, and benzylideneacetone. W. G.

Heterogeneous Catalysis and Adsorption. H. R. KRUYT and C. F. VAN DUIN (*Rec. trav. chim.*, 1921, **40**, 249—280).—The velocity of reaction in the case of certain chemical changes has been determined in the absence and in the presence of charcoal as an adsorbing agent. The velocities of hydrolysis of ethyl acetate, and of the sodium salt of methyl *p*-sulphobenzoate, the rate of fixation of bromine by sodium hydrogen *p*-sulphocinnamate, and the rate of decomposition of the sodium salts of *p*-sulphodibromohydrocinnamic acid are all diminished by the presence of charcoal. On the other hand, the reaction between potassium iodide and dibromopropionic acid is accelerated by the presence of charcoal.

The adsorption of these reacting substances alone or in the presence of the products of reaction has been examined. In most cases the adsorption is favoured by the presence of the products of reaction, but the results do not permit of the deduction of any definite theory as to the kinetics of the reactions. The results show that heterogeneous catalysis is not entirely due to an increase in the active mass, consequent on an increase of the concentration in the limit layer. This increase in the concentration may be equally well accompanied by an increase or a diminution in the velocity of the reaction, according as the adsorbed reagents are in a more or a less advantageous position. The results are discussed in the light of the theories of Langmuir (A., 1917, ii, 19, 525) and of Harkins (A., 1917, ii, 238, 239) with which they are in accord. W. G.

The Influencing of the Activity of Catalysts. II. Reduction of Acid Chlorides to Alcohol and Ester. KARL W. ROSENMUND, F. ZETZSCHE, and F. HEISE (*Ber.*, 1921, **54**, [*B*], 638—647).—In a previous communication (this vol., ii, 320) it has been shown that the catalytic reduction of acid chlorides can be so influenced by the addition of suitable substances that it ceases at the aldehyde stage; it is now demonstrated that such control can be so exercised that it proceeds to the next stage, namely, the formation of alcohol (which reacts with the excess of acid chloride) to yield the ester.

The reduction of benzoyl chloride by hydrogen and palladium in boiling xylene solution gives hydrocarbons of high boiling point (chiefly dibenzyl, about 45%), benzoic acid (16%), benzyl benzoate (15%), together with volatile substances such as toluene. Diminution of the partial pressure of the hydrogen increases the yield of ester from 15% to 37% and decreases that of complex hydrocarbons from 45% to 22%. The effect of specific addenda is described, the substances chosen being such as contain an element of varying valency; minute amounts of quinoline alter the course of the

reaction completely, the product being benzyl alcohol containing small amounts of benzaldehyde and dibenzyl ether, whereas hydrocarbons, benzoic acid, and benzyl benzoate are completely absent. Xanthone, on the other hand, has a purely quantitative effect, inducing a diminution in the production of complex hydrocarbons and an increase in acid and ester. The co-existence of the two latter substances is a result of the fission of the ester into acid and toluene under the influence of hydrogen. This action can be excluded by the addition of quinoline or, preferably, of toluene; the effect is not due to a lowering of the temperature of reaction, since it is very pronounced in the presence of xylene under the same conditions.

By a suitable combination of the actions of toluene and xanthone, suitable conditions are established for the production of ester as main product of the reaction. The presence of the latter prevents the catalyst from bringing about the reduction of alcohol to hydrocarbon whilst allowing the conversion of the acid chloride to aldehydes and alcohol. Toluene behaves as anti-ferment towards the reductive ester fission. H. W.

The Influencing of the Activity of Catalysts. III. Oxidative Catalytic Dehydrogenation of Alcohols. I. KARL W. ROSENMUND and FRITZ ZETZSCHE (*Ber.*, 1921, **54**, [*B*], 1092—1098. Compare this vol., ii, 320, and preceding abstract).—The catalytic oxidation of a primary alcohol may lead to the production of (1) aldehyde, (2) acid, (3) ether, and (4) condensation products. The reaction has been studied in the case of benzyl alcohol under conditions which do not necessitate vaporisation and with the object of limiting the scope of the change to the production of benzaldehyde. Benzyl alcohol gives only about a 3% yield of the latter when oxidised by oxygen in boiling cumene solution, and this yield is not very greatly increased in the presence of copper, silver, magnesium, platinum, nickel, aluminium, zinc, antimony, or carbon. Amongst these almost equivalent catalysts, selective action can be induced in the cases of copper, nickel, and silver by the suitable addition of quinoline, the production of benzaldehyde being favoured in the case of copper and of ether and condensation products in the cases of nickel and silver, thus affording an example of the transformation of slightly active catalysts into powerful and specific substances. The dehydrogenating action of catalytically excited oxygen and of nitro-groups is additive; the latter are preferably introduced in the form of *m*-dinitrobenzene. The best yields of aldehydes from alcohols are obtained by the catalytic oxidation of an equimolecular mixture of alcohol, quinoline, and *m*-dinitrobenzene in cumene solution in the presence of copper. H. W.

Mass-spectra and Atomic Weights. A Lecture delivered before the Chemical Society on April 7, 1921. By FRANCIS WILLIAM ASTON (T., 1921, **119**, 677—687).

Diameter of the Atoms. WILHELM H. WESTPHAL (*Zeitsch. Physik*, 1921, **4**, 254—256).—A theoretical paper in which on the basis of Rankine's explanation of the difference between the radii of the inactive gases and the halogens as found by Bragg from the crystal structure method and those found by the viscosity method, the author shows that it is possible to calculate the constants of the repulsion law (A., 1920, ii, 679). The values of $\log_{10} a+8$ are plotted against $\log_{10} a/r_0$ where a is the radius of the molecule and $2r_0$ the smallest distance between the molecules. The curves are practically straight lines in both cases. J. F. S.

Theory of Valency. I. The Behaviour of Decolorised Magenta Solutions. II. The Configuration of Benzene and the Organic Hydroxyl Group. JULIUS GNEZDA (*Rev. Chim.*, 1921, **1**, 17—23, 33—40).—Organic substances of many widely varying types (amides, amines, amino-acids, cyanogen compounds, aldehydes, proteins, etc.) generate a red colour with magenta solutions which have been decolorised by means of sodium sulphite or magnesium metal, the development of the colour usually taking place more easily when magnesium is the decolorising agent than when sodium sulphite is used. In certain instances, a colour is developed with magnesium–magenta solutions whilst no colour is formed with sulphite–magenta solutions. In order to explain these and similar facts, the author develops a theory of valency in which oxygen is considered to possess, besides its two principal valencies, two stronger and two weaker subsidiary valencies, which, in certain circumstances, radiate "ponderable or imponderable" matter into the surrounding space and may bring about reoxidation of the decolorised solution.

In the second paper, the author develops formulæ for various compounds in accordance with this theory. C. K. I.

Theory of Ammonium Salts and Co-ordination Compounds in Organic Chemistry. JEAN PICCARD and JEAN HENRI DARDEL (*Helv. Chim. Acta*, 1921, **4**, 406—417).—The authors discuss the central and co-ordination formulæ for ammonium chloride and similar compounds, and demonstrate that the hypothesis of the central formula, which has lost ground in inorganic chemistry, receives even less support from organic chemistry. A doubly-linked atom often occupies two co-ordination places, this being the only explanation possible for the isomerism of fumaric and maleic acids or of the oximes. On the other hand, it may readily be assumed that a doubly-linked radicle may be displaced by another radicle from one of its co-ordination positions and yet remain doubly linked electronically. According to this view, if the number of radicles grouped round the central element of a compound is smaller than the co-ordination number of such element, the latter is co-ordinately unsaturated.

In support of the above theory, it is pointed out (1) that ethylene is co-ordinately unsaturated, giving with water a crystalline compound differing from alcohol, and (2) that liquid ethylene and liquid hydrogen chloride are miscible in all proportions with develop-

ment of heat. The central formula is rendered applicable to oxonium and iodonium salts only by the introduction of arbitrary hypotheses, and becomes quite inadmissible as a means of expressing carbonium salts of the type described by Kehrmann and Effront (this vol., i, 348), for the reason that an element of the fourth group of the periodic system can only be quadrivalent.

As regards saturation, compounds may be divided into four classes: (1) Those unsaturated both electronically and co-ordinately, such as the unstable compounds, ferrous chloride, sulphur dioxide, nitrosobenzene, and triphenylmethyl. (2) Those unsaturated electronically, but saturated co-ordinately. Inorganic compounds of this type are often highly stable; there are but few organic compounds in this class, and potassium ferrocyanide, the additive compound of triphenylmethyl and ether, may be cited. (3) Compounds electronically saturated but co-ordinately unsaturated: silver chloride, calcium chloride, sulphur trioxide, ammonia, etc.; also aniline, dimethylaniline, nitrobenzene, *p*-benzoquinone, *p*-benzoquinonedi-imine and its hydrochloride, quinol, acetone, probably all unsaturated hydrocarbons and their derivatives, etc. (4) Compounds saturated from both points of view: cryolite, salts of metals with their maximum valencies and with water of crystallisation, methane, carbon tetrachloride, etc.

The cases of the atoms of nitrogen, carbon, sulphur, oxygen, and platinum are discussed, and the conclusion is drawn that the co-ordination positions are pre-existent in the atom. T. H. P.

Graphical Methods (Nomograms) for Chemical Calculations. J. BABINI (*Anal. Assoc. Quím. Argentina*, 1921, **9**, 34—43).—In the calculation of results which are functions of two or more variables, graphical methods (nomograms) may be conveniently employed. Two nomograms are developed. One is for the estimation of urea in urine, using the formula $0{\cdot}0747x = V/10{\cdot}273/T$ where x is the number of grams of urea per thousand, V the volume of nitrogen in c.c., and T, the absolute temperature. The other nomogram is for the evaluation of log $a/a-x$ in the study of unimolecular reactions. G. W. R.

Apparatus for Filtration in Anhydrous or Indifferent Gases. ARTUR WOLFRAM (*Ber.*, 1921, **54**, [*B*], 857—859).—The apparatus was primarily designed in connexion with the work of Steinkopf and his co-workers (this vol., i, 404) on the addition of cyanogen bromide to compounds of arsenic; it allows the preparation, filtration, and desiccation of a substance in a single operation and with complete exclusion of moisture. The reaction vessel consists of a round-bottomed flask provided with a tubulus in one side which permits the attachment of a dropping funnel into which a dried gas can be passed as required. The accurately-ground neck of the flask presses a hardened filter-paper against a perforated porcelain disk placed in a filter-tube similar to those used with Gooch crucibles, the junction between the tube and flask being made by a rubber ring. The narrow end of the filter-tube is attached by a two-holed rubber stopper to a separating funnel, the other hole allowing a

connexion to be made to the exhaust pump. The whole apparatus is mounted in a slightly inclined position and the reacting substances are mixed in the flask; it is then brought into a vertical position whereby the reaction mixture flows on to the filter-paper and the precipitate is filtered by suction. The filtrate is run off from the larger funnel and the necessary wash liquid is introduced through the smaller one. The precipitate is ultimately dried by aspirating a current of dry air or other suitable gas through it. H. W.

High Vacuum Methods in Chemistry. M. VOLMER (*Zeitsch. angew. Chem.*, 1921, **34**, 149—151).—The mercury vapour pump has a very high efficiency, and, when used in conjunction with a water-pump, is capable of reducing the pressure in a vessel of 1 litre capacity to 0·1—0·01 mm. within a few seconds. The pump may be used for distillations under low pressure, molecular weight determinations, thermal decompositions, etc. W. P. S.

Inorganic Chemistry.

Colour and Molecular Formula of Water and Ice. I. E. TOMKINSON (*Chem. News*, 1921, **122**, 205—208).—The theories as to the colour of water and ice are reviewed. The colour has been supposed to be due to selective absorption, to scattering by suspended particles, to a sky-effect, and (in the case of sea-water) to organic matter in solution. The first and fourth explanations are believed to cover all the facts. J. R. P.

The Atomic Weight of Chlorine in some Minerals. (MLLE) IRÈNE CURIE (*Compt. rend.*, 1921, **172**, 1025—1028).—The atomic weight of chlorine derived from three different minerals was determined. The values obtained for chlorine derived from a sample of sodalite (sodium aluminium chlorosilicate) from Canada, and from a sample of calcium chlorophosphate from Norway agree with the value for chlorine from sea-water. The value, 35·60, for chlorine from a sample of sodium chloride from a desert region in Central Africa was slightly high. W. G.

The Theory of Electrochemical Chlorate and Perchlorate Formation. N. V. S. KNIBBS and H. PALFREEMAN (*Trans. Faraday Soc.*, 1921, **16**, 402—433).—This paper, which is the outcome of a series of investigations undertaken to obtain data of importance for the technical control of the electrolytic chlorate and perchlorate process, is divided into three parts.

Part I records the results of conductivity measurements of solutions of sodium chlorate, mixtures of chloride and chlorate, perchlorate, and mixtures of chlorate and perchlorate and also the

results of experiments on the dynamics of the conversion of hypochlorite into chlorate. The conductivity of sodium chlorate was determined in solutions containing from 100 to 600 grams per litre between 20° and 80° at 10° intervals, and at higher temperatures than 40° the concentration was increased to 750 grams per litre. For a given concentration, the increase of conductivity with temperature is approximately linear. At constant temperature, the conductivity–concentration curve passes through a maximum which at 20° is at 530 and at 60° is at 600 grams per litre. The conductivities of a wide range of mixed sodium chloride–sodium chlorate solutions were determined between 20° and 80°. In general, with constant chloride, an increase of chlorate concentration at any temperature lowers the conductivity, whilst an increase of chloride with constant chlorate raises the conductivity, except at higher concentrations, where an increase of either salt lowers the conductivity. The conductivities of a limited range of mixed sodium perchlorate and chlorate solutions were determined between 20° and 60°, whilst pure sodium perchlorate solutions were examined only at 20° and 60° in concentrations up to 1100 grams per litre. The conductivity of perchlorate falls off considerably at higher concentrations.

The formation of chlorate from hypochlorite is represented by the equations :

$$OCl' + 2HOCl = ClO_3' + 2H^{\cdot} + 2Cl'$$
$$2OCl' + 2H^{\cdot} + 2Cl' = 2HOCl + 2Cl'$$

the net result being the disappearance of three hypochlorite ions with formation of one of chlorate and two of chloride. The second reaction is practically instantaneous, and the first, although apparently termolecular, follows a unimolecular course, since the concentration of hypochlorous acid remains constant. The velocity constant, $k' = 1/t \log_e a/a-x$, where a and x refer to concentration of NaOCl only, was determined between 40° and 80° for different concentrations of hypochlorous acid. The velocity constant increases with increasing concentration of HOCl. The velocity is proportional to the square of the hypochlorous acid concentration, hence $k'/[HOCl]^2$ = a constant k. From 60° to 80° k may be represented by the formula $k = e^{0\cdot 6 + 0\cdot 056t}$, but at lower temperatures this formula gives too high results.

Experiments are described in which the attempt was made to measure the ohmic resistance and electrode potentials of chlorate and perchlorate cells, but the exact nature of the *E.M.F.* and resistances measured cannot be interpreted.

II. *Chlorate Formation.*—The theory of chlorate formation in the chlorate cell and the sources of loss of efficiency are discussed. In the cell, working normally, an equilibrium is set up in which the hypochlorite formed by the current is equal to that which is being changed to chlorate by the reaction $OCl' + 2HOCl = ClO_3' + 2H^{\cdot} + 2Cl'$. Loss of efficiency may be due to reduction of the oxidised product by cathodic hydrogen or to evolution of anodic oxygen. The former is probably negligible in technical cells; the latter may be due to discharge of hydroxyl ions, of chlorate ions, or of hypochlorite

ions. It is concluded that the discharge of hypochlorite ions is the principal cause of loss of efficiency, the reaction taking place according to the equation $2OCl'+H_2O=2HOCl+O$. The loss of efficiency may be determined by estimating the quantity of oxygen in the cell gases. It was shown experimentally that, as the hypochlorite-ion concentration was increased by adding sodium hydroxide to a normally running cell to suppress the hypochlorous acid (which has an extremely low dissociation constant), the percentage of oxygen evolved increased in approximately linear proportion to the sodium hypochlorite concentration. The percentage of oxygen evolved decreased when the current density was increased, and vice versa, but after a time tended to return to its original value. An equation is deduced for expressing the efficiency of the cell in terms of hypochlorite concentration and temperature, and the constants of the equation are calculated from experimental results. The energy efficiency of the cell is also discussed.

III. *Perchlorate Formation.*—The theory of electrolytic perchlorate formation from chlorate put forward by Oechsli (A., 1904, ii, 22), and the alternative views of Bennett and Mack (A., 1917, ii, 199), are reviewed. The latter view rejects Oechsli's theory of chlorate-ion discharge and postulates direct oxidation of chlorate by active anodic oxygen. The present authors cannot uphold Bennett and Mack's objections to the discharge of chlorate ions, but, on the other hand, the mechanism of perchlorate formation from the discharged ions proposed by Oechsli appears unnecessarily complicated. Probably the reaction is similar to that of persulphate formation, thus:—$O_2ClO-+-OClO_2=[O_2ClO-]_2$; $[O_2ClO-]_2+H_2O=O_2ClO\cdot OH+O_2ClOH$. Contrary to what is generally stated, high efficiency can be obtained at as high a temperature as 60° if the current density is sufficiently great. It is shown that chloride may be produced during the electrolysis of chlorate, possibly by the reaction $4HClO_3=3HClO_4+HCl$. The amount of chloride formation increases with temperature, but may be largely prevented by the presence of chromate. The energy consumed in the perchlorate cell is discussed. E. H. R.

Preparation of Fluorine from Molten Potassium Hydrogen Fluoride. FRIEDRICH MEYER and W. SANDOW (*Ber.*, 1921, **54**, [*B*], 759—766).—The method is a development of that proposed recently by Argo, Mathers, Humiston, and Anderson (A., 1919, ii, 333).

The apparatus consists of a cylinder of Acheson graphite which acts as crucible and cathode. It is closely surrounded by a copper cylinder which is electrically heated. The anode is of Acheson graphite, and is made wider at the lower than at the upper end; at the former, six vertical grooves are cut into it to increase the amount of surface exposed. The diaphragm is composed of a copper cylinder to the lower end of which four conical copper rings are successively attached and, finally, a reversed ring fastened to a horizontal piece of copper foil. Details as to structure and insulation are given. Potassium hydrogen fluoride, which forms a clear mobile molten mass at 240°, is used as electrolyte, this being found

preferable to mixtures of the substance with sodium fluoride, sodium hydrogen fluoride, lead fluoride, or strontium fluoride by reason of its greater homogeneity and smaller evolution of hydrogen fluoride. The crucible is slowly heated to a temperature not exceeding 250°, and, since the molten salt obstinately retains traces of water, the electrolysis is commenced with a small current, which is continued until the impurity has been completely decomposed, after which the electrolysis proper is commenced. When the bath has been in use for some time, the temperature may be increased to 270°, but it is not advisable to go beyond this point, as the gas is then liable to carry solid matter with it, and thus to cause a stoppage of the tubes, a leakage of fluorine into the hydrogen, and consequent explosion. For the same reason, when disconnecting the apparatus it is necessary to ensure the escape of the hydrogen before dismantling.

The fluorine evolved at the beginning of an experiment contains considerable quantities of ozone, which practically disappears after one-half to three-quarters of an hour. Any volatilised hydrogen fluoride can be removed quantitatively by passage over granular sodium fluoride. The anode is very slightly attacked, and the gas contains not more than 0·2% of carbon tetrafluoride. The current yield is more than 75% of that theoretically possible. H. W.

The Number of Molecules per Cubic Centimetre of Oxygen obtained by the Dispersion. C. STĂTESCU (*Bull. Acad. Sci. Roumaine*, 1920, **6**, 164—167).—The value of $2·73 \times 10^{19}$ at S.T.P. is deduced by an application of Drude's formulæ. J. R. P.

Tellurium Tetraiodide. A. DAMIENS (*Compt. rend.*, 1921, **172**, 1105—1107. Compare this vol., ii, 110, 257).—Tellurium tetraiodide may readily be prepared in a pure state by heating finely powdered tellurium with an excess of iodine and allowing the mixture to cool slowly. The tetraiodide crystallises out and the excess of iodine may be extracted with carbon tetrachloride. If a further purification is desired, the product is heated in a sealed tube for several hours at 150—160°. So prepared, tellurium tetraiodide has m. p. 280°; D^{15} 5·05. Above 100°, it readily dissociates into tellurium and iodine. The tetraiodide serves as a useful starting material for the preparation of numerous derivatives of tellurium. W. G.

Graphitic Acid—a Colloidal Oxide of Carbon. GEO. A. HULETT and O. A. NELSON (*Trans. Amer. Electrochem. Soc.*, 1920, **37**, 425—439. Compare A., 1916, ii, 31).—The flakes of graphitic acid are shown by the use of polarised light to have a colloidal structure; this view is supported by the fact that the vapour pressure curves of graphitic acid are continuous. It is suggested that the substance is a solid oxide of carbon, having the probable formula C_3O or $C_{11}O_4$. CHEMICAL ABSTRACTS.

Silicon Hydrides. X. Compounds containing Nitrogen. ALFRED STOCK and KARL SOMIESKI (*Ber.*, 1921, **54**, [*B*], 740—758). —Chlorosilane and ammonia react in the gaseous phase at the

ordinary temperature with formation of ammonium chloride, the change occurring most simply in the presence of excess of the former and leading to the quantitative production of *trimonosilylamine*, $N(SiH_3)_3$, m. p. $-105\cdot6°$, $D^{-106°}$ 0·895, b. p. 52°, tensions 0·1 mm. $-80°$; 0·5 mm. $-70°$; 1·0 mm. $-65°$; 2 mm. $-60°$; 3 mm. $-55°$; 5 mm. $-50°$; 7 mm. $-45\cdot0°$; 10 mm. $-40°$; 14 mm. $-35\cdot0°$; 21 mm. $-29\cdot4°$; 29 mm. $-24\cdot4°$; 38 mm. $-20\cdot4°$; 52 mm. $-14\cdot4°$; 65 mm. $-11\cdot0°$; 89 mm. $-4\cdot2°$; 109 mm. 0°; 137 mm. $+5\cdot0°$; 172 mm. 10°; 212 mm. 15·0°. It is a spontaneously inflammable liquid which is stable in the absence of air, and is vigorously decomposed by water, $N(SiH_3)_3+6H_2O=3SiO_2+NH_3+9H_2$. Its vapour density corresponds with the simple formula, $N(SiH_3)_3$. It does not combine with hydrogen chloride or monochlorosilane.

A homogeneous substance could not be isolated from the product of the action of monochlorosilane and an excess of ammonia. The chlorine is immediately converted into ammonium chloride, whilst the silicon remains primarily in the form of volatile compounds in the gaseous phase. The initial product is chiefly *dimonosilylamine*, $NH(SiH_3)_2$, probably admixed with the corresponding tri- and mono-amines. The diamine is only comparatively stable in the dilute gaseous condition, and decomposes gradually according to the equation $NH(SiH_3)_2=SiH_4+SiH_2{:}NH$. The latter cannot exist in the unimolecular form, and condenses rapidly to the solid polymeride, $(SiH_2{:}NH)_x$. To a smaller extent, evolution of ammonia occurs in accordance with the scheme:

$$SiH_3{\cdot}NH_2 \longrightarrow NH(SiH_3)_2 \longrightarrow N(SiH_3)_3.$$

The composition of the final residue corresponds with that of a mixture of $(SiH_2{:}NH)_x$ and $N(SiH_3)_3$.

Dichlorosilane reacts with an excess of ammonia at the ordinary temperature in accordance with the scheme $SiH_2Cl_2+3NH_3=2NH_4Cl+SiH_2{:}NH$. Since the latter compound polymerises immediately, only the excess of ammonia remains in the gaseous phase. Reaction does not proceed quantitatively, which is probably explained to a great extent by the fact that the products separate in the solid condition and the intermediate substances thus become covered by layers of material which shield them from the further action of the ammonia. The *polymeride*, $(SiH_2{:}NH)_x$, is a white substance resembling silicic acid. The value of x is certainly very considerable, since examination of the compound produced in benzene solution showed $x=7$—8; the residue obtained by evaporation of the solvent was, however, a viscous liquid which only slowly passed into the solid, doubtless more highly polymerised, condition. The polymeride is decomposed by sodium hydroxide solution, $SiH_2{:}NH+2H_2O=SiO_2+2H_2+NH_3$, the same change being more slowly brought about by water.

In general, the compounds containing nitrogen exhibit a close analogy to the corresponding substances containing oxygen. Thus, the conversion of $NH_2{\cdot}SiH_3$ into $NH(SiH_3)_2$ in the presence of an excess of ammonia is paralleled by the formation of $O(SiH_3)_2$, and not $SiH_3{\cdot}OH$ by the action of an excess of water on monochlorosilane; the conversion of the volatile unimolecular SiH_2O

into $(SiH_2O)_x$ is similar to that of $SiH_2{:}NH$ into $(SiH_2{:}NH)_x$, and affords a further example of the remarkable tendency towards polymerisation of substances which contain but few hydrogen atoms directly united to silicon.

The behaviour towards gaseous hydrogen chloride is remarkable; mono-, di-, and tri-silylamines are smoothly and quantitatively transformed into monochlorosilane and ammonium chloride. With the solid polymeride, $(SiH_2{:}NH)_x$, the action, $SiH_2{:}NH+3HCl+SiH_2Cl_2+NH_4Cl$, occurs more slowly and passes through several intermediate phases. The ready replaceability of the Si-N group by Si-halogen appears to be quite general with silicon compounds.

H. W.

The Solubility of Different Potassium Salts in Mixtures of Water and Alcohol. M. Pierrat (*Compt. rend.*, 1921, **172**, 1041—1043).—The solubility in aqueous alcohol of varying strengths at 14° and the electrical conductivity of solutions containing the same weight of salt in the same volume of water have been determined for potassium hydrogen tartrate, potassium perchlorate, potassium platinichloride, potassium silicofluoride, and potassium cobaltinitrite.

W. G.

Decomposition of Sodium, Potassium, Ammonium, and Aniline Hydrogen Sulphates and Potassium Binoxalate and Tetraoxalate by Solvents. Th. Sabalitschka (*Ber. Deut. pharm. Ges.*, 1921, **31**, 183—198).—The crystallisation of aqueous solutions of potassium, sodium, ammonium, or aniline hydrogen sulphates results in the formation to a greater or lesser degree of the normal salt and the free acid. Thus pure potassium sulphate was deposited from a solution of pure potassium hydrogen sulphate, whilst a mixture of the normal and acid salts was obtained in the other cases. The addition of alcohol to an aqueous solution of sodium hydrogen sulphate caused the precipitation of the pure normal salt. The precipitate obtained in a similar way with ammonium hydrogen sulphate solutions contained 60—70% of the normal salt. The prolonged extraction of the dry hydrogen sulphates with alcohol in a Soxhlet apparatus likewise resulted in the removal of an excess quantity of the acid, leaving a residue of the normal sulphates in the case of the potassium and sodium salts, and a mixture in the case of the ammonium and aniline salts. The extraction of potassium tetraoxalate with ether and alcohol resulted in a similar decomposition into free acid and a residue of binoxalate, the latter being unchanged by the further action of the solvents.

G. F. M.

Dissolved Gases in Glass. Edward W. Washburn, Frank F. Footitt, and Elmer N. Bunting (*Univ. Ill. Bull.* 18, 1920).—All varieties of glass contain dissolved gases which are evolved, with great effervescence and expansion of the glass, when the latter is heated at atmospheric pressure in a vacuum furnace and then suddenly connected to a large vacuum chamber. The amount and composition of the dissolved gas varies with the type of glass and conditions of manufacture. In three types of glass examined the

gases at *N.T.P.* measured 0·2 to 2·0 times the volume of the glass itself. Carbon dioxide, oxygen, and nitrogen (in varying amounts) were the chief constituents. The apparatus used is fully described and illustrated. [See also *J. Soc. Chem. Ind.*, 1921, June.]

A. B. S.

Positive-ray Analysis of Magnesium. A. J. DEMPSTER (*Science*, 1920, **52**, 559. Compare *Physical Rev.*, 1918, **11**, 316).—When a magnesium anode is heated to vaporise it slightly, three isotopes of atomic weight respectively 24, 25, and 26 appear in amounts proportionally 6 : 1 : 1, giving an average atomic weight of 24·375 as compared with the chemically determined value, 24·36.

CHEMICAL ABSTRACTS.

Electromotive Behaviour of Magnesium. I. A. SMITS and R. PH. BECK (*Proc. K. Akad. Wetensch. Amsterdam*, 1921, **23**, 975—976).—As a preliminary to the investigation of the electromotive behaviour of magnesium and magnesium mercury alloys, which on the whole resemble aluminium and the aluminium mercury alloys in this respect (compare A., 1920, ii, 579, this vol., ii, 371), the melting point–composition diagram of alloys of magnesium and mercury has been determined over the whole range of compositions. The diagram indicates the presence of the compounds $MgHg_2$, $MgHg$, Mg_3Hg_2, Mg_2Hg, Mg_3Hg, and possibly Mg_2Hg_3. In order to ascertain what corrections must be applied in the concentration for the mercury existing in the vapour phase, the vapour tension of the different mixtures up to 50% mercury has been determined using a glass spring indicator. The results, of which no details are given, indicate that up to this concentration the vapour tensions are very small, even at the melting point of the alloy.

J. F. S.

The Theory of Smelting. II. Equilibria between Pairs of Metals and Sulphur. I. The System: Copper–Lead–Sulphur. W. GUERTLER and K. L. MEISSNER (*Metall & Erz*, 1921, **18**, 145—152).—In a former paper it was shown by Guertler (*ibid.*, 1920, **17**, 192) that when sulphur is added to a mixture of copper and lead, cuprous sulphide is first formed, then lead sulphide, and finally cupric sulphide, and these relations were shown on a triangular diagram. In this diagram the ternary system is divided into three partial systems, (*a*) Pb–Cu–Cu_2S; (*b*) Pb–Cu_2S–PbS, and (*c*) Cu_2S–PbS–S. Thermal and microscopic examination has now been made of a number of mixtures corresponding with points in each of these partial systems. Each pair of constituents in the first partial ternary system shows incomplete miscibility, and consequently an area of incomplete miscibility would be expected in the ternary system, with three separate phases. Actually only two layers are formed, the upper consisting essentially of cuprous sulphide, the lower being an emulsion of lead and copper in which the lead shows a pronounced tendency to liquate downwards. Through this emulsion formation, copper and lead can be made practically completely miscible by addition of 1—1·5% of sulphur. Addition of lead to the Cu–Cu_2S system extends the miscibility gap.

In the partial system Pb–Cu_2S–PbS, a miscibility gap extends almost up to the Cu_2S–PbS line. In absence of free lead, that is, on the Cu_2S–PbS line, there is no gap, but eutectic mixtures only are formed. In the third partial system, Cu_2S–PbS–S, it was expected that the line PbS–CuS would correspond with a quasi-binary series of mixtures, but, owing to the dissociation of cupric sulphide into cuprous sulphide and sulphur on melting, equilibrium was established between lead sulphide, cuprous sulphide, and an apparently ternary crystalline phase. Mixtures richer in sulphur were not further investigated. E. H. R.

Possibility of Separating Mercury into its Isotopic Forms by Centrifuging. J. H. J. Poole (*Phil. Mag.*, 1921, [vi], **41**, 818—822).—In a centrifuge running at 60,000 revolutions per minute a difference of density of mercury of 1½ parts per 1000, due to separation of the isotopes, should be produced. With liquid neon, a difference of 10% should be obtained. J. R. P.

The Physical Properties of Mercury. Alfred Schulze (*Zeitsch. Metallkunde*, 1921, **13**, 105—113, 139—148).—A review of the literature dealing with the determination of the magnitudes of the physical properties of mercury, grouped under the headings mechanical, thermal, electrical and magnetic, and optical. E. H. R.

Action of Sodium Sulphide on Ferric Oxide. J. C. Witt (*J. Amer. Chem. Soc.*, 1921, **43**, 734—740).—When ferric oxide is treated with an excess of sodium sulphide, a black, amorphous substance is formed. On removing most of the remaining sodium sulphide and adding water, a brilliant green solution is produced. The results obtained on studying the solution indicate that the colour is due to a colloid and not to a true solution of some iron compound. The exact composition of the disperse phase has not been determined, but apparently it contains neither sulphur nor sodium in chemical combination. The colloid is reversible. It is precipitated by a relatively large amount of sodium sulphide, and is regenerated when the precipitating agent is removed. Sodium sulphide acts also as a protecting agent. The sol can only exist in the presence of a small amount of the sulphide. When the last trace is removed, either by dialysis or by oxidation, the colloid is precipitated. By drawing air through the sol until the sulphide is oxidised to sulphate a new sol is prepared. This is brown in colour and apparently consists of colloidal hydrated ferric oxide. The iron compound is eventually precipitated, although it may remain colloidal for a long time. The green sol contains less than 0·07 gram of iron per litre, and cannot be dialysed in the presence of air. It is therefore exceedingly difficult to determine the exact composition of the disperse phase. J. F. S.

The Constitution of Smalt. A. Duboin (*Compt. rend.*, 1921, **172**, 972—974).—Using the method previously described (A., 1892, 1161, 1286), the author has produced deep blue cobalt compounds

similar to smalt. The first had the composition $K_2O,CoO,3SiO_2$ and the second the composition $KCl,K_2O,CoO,4SiO_2$. W. G.

The Introduction of Silicic Acid into the Nucleus of Complex Compounds. ROBERT SCHWARZ and HANS BAUSCH (*Ber.*, 1921, **54**, [*B*], 802—813).—The idea has been occasionally expressed that silicic acid is present in natural minerals, particularly those containing aluminium, in the complex form rather than as the simple silicate, but very little experimental evidence on the point has been brought forward. It is now shown, however, that silica very readily enters the cobaltammine complex, thus supporting the possibility of the hypothesis mentioned above.

Chloropentamminocobalt chloride and hexamminecobalt chloride react smoothly and without formation of by-products when mixed with solutions of homogeneous, crystalline sodium silicate in perfectly definite proportions and concentrations of solution. With the first-named, *chlorotriamminotetrasilicatocobalt*,

$$\begin{matrix}Cl \\ (H_3N)_3\end{matrix}\!\!>\!Co\!<\!\!\Big\}Si_4O_9,$$

is formed as a reddish-violet, neutral precipitate which when moist has plastic properties resembling clay. Under the microscope, it appears to be non-crystalline. It decomposes above 120°, with the formation of cobalt tetrasilicate: $[Co(NH_3)_3ClSi_4O_9]=CoSi_4O_9+3NH_3+Cl$. It is stable towards water or cold, dilute hydrochloric acid, but is decomposed by the latter in boiling solution with quantitative separation of silicic acid. It is also decomposed by hot, concentrated sodium hydroxide solution. Under similar conditions, hexamminecobalt chloride give a mixture of *silicatotetramminecobalt chloride*, $[Co(NH_3)_4Si_4O_9]Cl$, and *silicatotetramminecobalt silicate*, $[Co(NH_3)_4Si_3O_7]_2SiO_3$. The former is most conveniently prepared by the use of a large excess of the *luteo*-chloride and forms a yellowish-orange precipitate, very sparingly soluble in water. It is readily decomposed by dilute mineral acids, or even by acetic acid, with complete elimination of silica and in this respect resembles the carbonato-complex salts. It decomposes when heated, with production of cobalt tetrasilicate. The latter is obtained when a relatively large excess of sodium silicate is employed, and is of particular interest, since it represents the first synthetic silicato-silicate. It is a yellow powder. The analytical separation of the nuclear and acid silicic acid has not yet been accomplished and the distribution therefore appears at first sight to be arbitrary, but is justified by the behaviour of the two compounds described previously, in each of which the silicic acid accumulates in the nucleus and by the observation that simple metasilicates are invariably formed by the action of sodium metasilicate on metallic salts unless complex formation occurs. The behaviour towards heat also differs from that of the above compounds, which yield pure cobalt tetrasilicate, whilst this one gives a non-homogeneous, greyish-blue product.

The tendency of silicic acid to form complex compounds is particularly shown by the formation of the *substance* $[Co(NH_3)_4Si_4O_9]OH$, a

dull orange-yellow precipitate, instead of the silicate, $[Co(NH_3)_6]_2SiO_3$, by the action of the free *luteo*-base with dioxodisiloxane.

The requisite pure sodium silicate is prepared by fusing the calculated quantities of sodium carbonate and powdered quartz in a platinum crucible at 1100° and allowing the product to cool very slowly. H. W.

Action of Sodium Carbonate on Chrome Alum Solutions. L. MEUNIER (*J. Soc. Leather Trades Chem.*, 1921, **5**, 103—111).—Chrome alum solutions undergo hydrolysis and the basic chromic salts so formed polymerise under the action of heat and more slowly on keeping. The neutralisation of the sulphuric acid formed by hydrolysis by the sodium carbonate, is accompanied by the liberation of carbon dioxide, and this is expelled from the solution by increase of temperature or agitation. The degree of ionisation of the carbon dioxide is influenced by the liquor in which it is produced. Precipitation is due to the sodium carbonate acting as a neutralising agent and also as a coagulating agent on the colloidal solutions of the chromium hydroxide or the polymerised basic chromium salts. D. W.

The Tempering of Brasses containing Tin. LÉON GUILLET (*Compt. rend.*, 1921, **172**, 1038—1041).—The special constituent which occurs in brasses with tin, when the percentage of tin is sufficiently high, has the effect, when the tempering is such that this constituent goes into solution, of considerably improving the mechanical properties of the alloy. Thermal anomalies appear with the special constituent, which possesses the same transformation as the δ-constituent of bronzes. This constituent dissolves at 350° in the β-constituent of brasses. If the alloy contains lead, this does not disappear in the tempering. Tempering at 600° considerably improves alloys containing this constituent, there being a marked increase in the breaking strain, the resilience, and the hardness. W. G.

Revision of the Atomic Weight of Antimony. Analysis of Antimony Bromide. H. H. WILLARD and R. K. MCALPINE (*J. Amer. Chem. Soc.*, 1921, **43**, 797—818).—In an all-glass apparatus, three preparations of antimony were combined with bromine, the resulting product was twice distilled under a pressure of 5—10 mm. as long as gaseous materials could be removed, and then distilled a third time under a pressure of less than 1 mm. into a series of small bulbs which were sealed off as filled. From the time the pure dry materials were placed in the apparatus until the bulbs were broken under tartaric acid only inert gases came into contact with the preparation. The resulting product was analysed for bromine in two ways: first by finding the amount of silver equivalent to the sample in the usual way; secondly, by adding excess of silver nitrate, filtering, and weighing the silver bromide. The precautions taken and the corrections applied include all those described within recent years for similar work. In eleven analyses a total of 46·76580 grams of antimony bromide required 41·86463 grams of silver and formed 72·88245 grams of silver bromide. The ratios are 1·117074

and 0·641611, from which the respective values for the atomic weight of antimony would be 121·799 and 121·755. If for the ratio $SbCl_3$: 3AgBr, three samples are omitted, because in these cases the fused silver bromide did not give a clear mass, the weights would be 35·69757 of antimony bromide to 55·63121 of silver bromide corresponding with an atomic weight of 121·767. The ratios of silver to silver bromide are 0·574413 and 0·574427, according to whether the imperfect silver bromide determinations are included or omitted. Baxter's determinations of this ratio gave 0·57445. Averaging the volumetric results for the eleven samples with the gravimetric results for eight samples, the most probable atomic weight for antimony becomes 121·773 (Ag=107·880). J. F. S.

Structure of Gold Amalgams as determined by Metallographic Methods. S. A. BRALEY and R. F. SCHNEIDER (*J. Amer. Chem. Soc.*, 1921, **43**, 740—746).—Freezing point-composition curves have been constructed for gold amalgams of compositions varying between 8% and 95% of mercury and a phase diagram has been produced. It is found that in the system gold-mercury there are two eutectics and three compounds, namely, Au_2Hg; Au_2Hg_3; and $AuHg_4$. The compound Au_2Hg freezes at 490°, and forms a eutectic with the solid solution which freezes at 390°. The eutectic has the composition 25 atomic% mercury. The compound Au_2Hg_5 does not form a true eutectic with the compound Au_2Hg. The compound $AuHg_4$ forms a concealed maximum at 100°. This concealed maximum is a break in the curve which is due to the decomposition of the compound $AuHg_4$ at its melting point into Au_2Hg_5 and Hg. This compound forms a eutectic at −41° with the solution of gold in mercury. J. F. S.

Mineralogical Chemistry.

Cesarolite, a New Mineral. H. BUTTGENBACH and C. GILLET (*Ann. Soc. Géol. Belg.*, 1920, **43**, *Bull.*, 239—241).—Small globules aggregated as friable, spongy masses of a steel-grey colour and resembling coke in appearance occur in cavities in galena from Tunis. D 5·29. The mineral is soluble in hydrochloric acid with evolution of chlorine. Analysis gave:

Pb.	MnO.	H_2O	O.	Fe.	Al.	Other metals.	Na_2O.	Insol.	Total.
36·29	42·65	3·30	13·26	0·49	0·79	0·36	0·18	0·75	98·07

Nitric acid extracts only a small part of the manganese (MnO 3·35%), and assuming this to be present as hausmannite the formula is deduced as $PbO,3MnO_2,H_2O$. This is a salt of the acid $H_4Mn_3O_8$, analogous to romanechite. L. J. S.

Minerals from the Limestone Quarries of Pargas, Finland. AARNE LAITAKARI (*Bull. Comm. Géol. Finlande*, 1921, no. 54, 1—114).—A detailed account is given of several crystallised minerals,

occurring in crystalline limestone, for which this locality is famous. Analyses are given of the following: Oligoclase as colourless, tabular crystals; the optical extinctions and *D* correspond with the composition $Ab_{70}An_{30}$; anal. I by P. Eskola. Diopside as black crystals; anal. II corresponds with 86% of the molecule $Ca(Mg,Fe)Si_2O_6$; the optical constants are given. Amphibole (var. pargasite), anal. III—V of crystals of three types, III and IV black and V green: the optical constants are given for each and plotted against the composition. The formulæ hitherto proposed for amphibole are

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	CaO.	MgO.	K_2O.	Na_2O.	H_2O.	F.	Total.	Sp. gr.
I..	59·57	—	25·65	0·27	—	6·51	—	1·34	6·47	—	—	99·81	2·653
II..	49·70	0·43	1·73	4·76	10·61	22·67	9·61	0·19	0·43	0·13	—	100·06	3·42
III..	42·05	0·91	12·60	1·60	11·51	11·85	13·48	1·90	1·97	0·48	1·82	99·41	3·189
IV..	43·90	0·70	12·52	0·38	5·95	12·69	18·91	1·30	1·34	0·61	2·29	99·63	3·186
V..	48·10	0·10	11·05	0·67	1·65	12·50	20·60	1·24	2·54	0·82	1·90	100·37	3·069
VI..	17·6	—	39·6	trace	—	13·0	21·6	—	—	8·1	—	99·9	3·093

discussed, and none of them found to agree closely with the new analyses; possibly certain constituents are present in solid solution. Material heated for two hours at 1000° (*i. e.*, about 100° below the melting point) lost 0·30%, but suffered no essential change in its optical characters. Clintonite (A. Laitakari, *Teknikern, Helsingfors*, 1918, 13) occurs as colourless to pale-green mica-like crystals; anal. VI. Massive löllingite gave on analysis by E. Ingman:

As.	S.	Fe.	Co.	Ni.	SiO_2.	Total.	Sp. gr.
63·08	3·42	28·95	1·22	0·29	0·45	97·41	7·275

Partial analyses are also given of garnet and apatite.

L. J. S.

Augite from Nishigatake, Japan. Ryōichi Ōhashi (*Min. Mag.*, 1921, **19**, 173—180).—A detailed crystallographic and optical description is given of olive-green to black crystals of augite found loose in decomposed basalt. Analysis gave:

SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	CaO.	MgO	Total.	Sp. gr.
51·37	0·58	5·24	2·02	2·96	21·58	16·94	100·69	3·338

corresponding with 74·6% of the diopside molecule, $CaMgSi_2O_6$.

L. J. S.

Formation and Constitution of Kaolin. Victor J. Bernaola (*Anal. Soc. Quím. Argentina*, 1920, **8**, 392—400).—A theoretical discussion of the mode of formation of kaolin and the supposed occurrence of crystalline particles associated with it. Assuming kaolin to be formed by the removal of sodium, potassium, or calcium silicates from felspars by solution, the formation of crystals is excluded and the crystalline forms observed are merely pseudomorphs after felspars. The porous character of kaolin particles implied by its origin as a metasomatic product from felspars would account for the plastic properties of clays. G. W. R.

The Meteorites of Mount Ayliff, Simondium, Adare, and Ensisheim. G. T. Prior (*Min. Mag.*, 1921, **19**, 163—172).—The meteoric iron of Mount Ayliff, Griqualand East, South Africa, was found some time previous to 1907 and weighed about 30 lb. Etched

surfaces show it to have the structure of a coarse octahedrite. Analysis of a portion free from inclusions of graphite and troilite gave :

Fe.	Ni.	Co.	S.	P.	C.	Total.
91·73	6·59	0·69	0·12	0·12	0·51	99·76

Another specimen of the Simondium, Cape Colony, meteorite (A., 1910, ii, 315; 1918, ii, 326) showed on polished surfaces residual grains of unoxidised metal, analysis of which yielded: Ni, 23·79; silicates, 5·67; Fe(+Co) by diff., 70·54. This meteorite is thus rich in nickel, with Fe : Ni about 3; it is still classed with the mesosiderites.

With the idea of testing the theory (A., 1916, ii, 633) that the ratio of MgO : FeO in the ferromagnesian silicates of meteorites varies directly with the ratio of Fe : Ni in the nickel-iron, the following new analyses were made of two meteorites, one (Adare, Co. Limerick; fell Sept. 10, 1813) containing a large amount of iron poor in nickel, and the other (Ensisheim, Alsace; fell Nov. 16, 1492) a small amount very rich in nickel. From detailed analyses of the portions attracted and unattracted by a magnet and of the silicate portions soluble and insoluble in hydrochloric acid, the bulk-analyses are deduced, I for Adare, II for Ensisheim.

	Nickel-iron.			Troilite.					
	Fe.	Ni.	Co.	Fe.	S.	SiO_2.	Al_2O_3.	Cr_2O_3.	FeO.
I	16·81	1·51	0·12	3·57	2·03	36·88	1·50	0·59	9·94
1	2·51	0·72	0·06	4·18	2·41	40·00	1·90	0·34	18·05
	MnO.	NiO.	CaO.	MgO.	Na_2O.	K_2O.	H_2O.	P_2O_5.	Total.
I	0·15	0·19	1·86	23·32	0·95	0·14	0·68	0·27	100·51
II	0·30	0·46	2·04	25·14	0·94	0·12	0·27	0·26	99·70

The corresponding mineralogical composition is for I: felspar, 7·52; chromite, 0·87; apatite (merrillite ?), 0·63; bronzite (in which MgO : FeO=about 5), 33·83; olivine (MgO : FeO=about 4), 32·64; nickel-iron (Fe : Ni=11), 18·46; troilite, 5·60%; and for II: felspar, 9·32; chromite, 0·51; apatite (merrillite ?), 0·59; hypersthene (MgO : FeO=3), 23·64; olivine (MgO : FeO=2½), 55·03; nickel-iron (Fe : Ni=3½), 3·29; troilite, 6·59%. L. J. S.

Meteoric Stone of Crumlin, Co. Antrim. SIR LAZARUS FLETCHER, with analysis by G. T. PRIOR (*Min. Mag.*, 1921, **19**, 149—162).—This stone weighing 4239 grams, D 3·553, was seen to fall on September 13, 1902, at Crosshill near Crumlin. A detailed account is given of the circumstances of the fall. Analysis I (by L. F.) of the silicate portion soluble in hydrochloric acid corresponds with an olivine $3Mg_2SiO_4Fe_2SiO_4$. The bulk-analysis II (by G. T. P.) gives the mineralogical composition : felspar, 10·38; chromite, 0·87; ilmenite ? ($FeTiO_3$), 0·32; apatite ?, 0·59; pyroxene (in which MgO : Fe=about 5), 30·15; olivine (MgO : FeO=3), 43·67; nickel-iron (Fe : Ni=about 7), 8·98; troilite, 5·25%.

	SiO_2.	TiO_2.	Al_2O_3.	Cr_2O_3.	FeO.	MnO.	CaO.	MgO.	Total.
I	39·39	—	0·20	—	21·32	0·33	1·43	37·05	199·72
II	40·73	0·17	2·14	0·60	13·24	0·27	2·04	25·36	—
				Nickel-iron.			Troilite.		
	Na_2O.	K_2O.	P_2O_5	Fe.	Ni.	Co.	Fe.	S.	Total.
II	1·07	0·11	0·26	7·75	1·15	0·08	3·34	1·91	100·22

Microscopical examination of thin sections shows that the stone may be classed as a grey hypersthene- (to bronzite-) chondrite.

L. J. S.

Analytical Chemistry.

The Importance of Adsorption in Analytical Chemistry. IX. Glasswool as a Filter Material. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 463—471).—Water and alkali attack glasswool slowly, hydrochloric acid more quickly, the effect increasing with the concentration of the acid. At the ordinary temperature, salts of metals and of the alkaloids are taken up very slowly, but at higher temperatures the speed is greatly increased. The effects appear to be due to the alkaline character of the glasswool, and are independent of the concentration of the salts, so that for very dilute solutions the loss may become relatively very great, especially where warm solutions are filtered through the material.

S. I. L.

Guanidine Carbonate as a Standard Alkali. A. H. DODD (*J. Soc. Chem. Ind.*, 1921, **40**, 89—90T).—Guanidine carbonate, prepared from dicyanodiamide, is readily obtained in a pure state by precipitating it from its aqueous solution with alcohol; it is non-hygroscopic, and the author recommends it for use in standardising acid solutions.

W. P. S.

Colorimetric Estimation of Hydrogen-ion Concentration of Small Amounts of Fluid. LLOYD D. FELTON (*J. Biol. Chem.*, 1921, **46**, 299—305).—One drop of the fluid is mixed on a porcelain plate with one drop of an indicator solution, and the colour is compared with that of similar mixtures made from buffer solutions of known P_H. In order to get approximate results rapidly over a fairly wide range, Clark and Lubs's indicators were employed, mixed in pairs; for instance, thymol-blue and bromophenol-blue for P_H 1·2—4·6 and methyl-red and bromothymol-blue for P_H 4·6—7·6.

G. B.

Estimation of the Hydrogen-ion Concentration of Potable Water. I. M. KOLTHOFF (*Zeitsch. Nahr.-Genussm.*, 1921, **41**, 112—122).—A method is described in which the hydrogen-ion concentration is estimated colorimetrically, using Neutral-red as the indicator, comparison being made with acid and alkaline solutions of the same indicator contained in graduated wedge-shaped tubes and standardised previously against a buffer mixture of known hydrogen-ion concentration. The total carbon dioxide content of the water may be calculated from the hydrogen-ion concentration and the hydrogen carbonate content.

W. P. S.

Detection of Hydrochloric Acid in the Presence of Hydrobromic Acid and Hydriodic Acid. G. G. LONGINESCU and GABRIELA CHABORSKI (*Bull. Acad. Sci. Roumaine*, 1920, **6**, 122—124).—A small quantity of the dry mixed salts is heated in a test-tube with a mixture of two parts of ethyl alcohol and one part of concentrated sulphuric acid, a funnel containing a filter-paper moistened with silver nitrate solution being placed in an inverted position over the mouth of the test-tube. The hydrochloric acid evolved is absorbed by the silver nitrate; the hydrobromic acid is decomposed partly and yields ethyl bromide and dibromoethane, whilst the hydriodic acid is decomposed almost completely. The greater part of the iodine remains in the solution, but a small quantity volatilises and is absorbed by the filter-paper, but remains insoluble when the silver chloride is dissolved in ammonia. If the heating is continued after all hydrochloric acid has been expelled, the bromoethanes and iodine are evolved and may be collected by holding a beaker moistened with water over the test-tube; the beaker is then rinsed out and the solution treated with carbon disulphide and chlorine-water. The latter is added until the violet coloration due to the iodine disappears, when the brown coloration of the bromine remains. If nitrates are present in the original mixture, diphenylamine should be added to the sulphuric acid used in the test. W. P. S.

Electrometric Titration of Hypochlorous Acid. W. D. TREADWELL (*Helv. Chim. Acta*, 1921, **4**, 396—405).—The influence of acidity and alkalinity on the titration of hypochlorous acid with arsenious acid and with potassium iodide has been investigated. In either case, electrometric titration furnishes a highly exact and trustworthy indication of the end point. [Compare *J. Soc. Chem. Ind.*, 1921, 387A.] T. H. P.

Iodometric Studies. I. The Estimation of Iodine by Titration with Sodium Thiosulphate. BOHDAN KOHLER (*Chem. Listy*, 1920, **14**, 137—140, 195—199).—In titrating iodine in acid medium with sodium thiosulphate the presence of a large excess of iodine ions may cause an indefinite end point. More than the theoretical amount of the thiosulphate is required because a portion is used up in a secondary reaction with hydriodic acid. To limit the ionic concentration of the iodine the use of potassium thiocyanate instead of potassium iodide is recommended as an aid in dissolving the iodine (see Bruhns, A., 1920, ii, 773). When using this salt, a minimum acidity of $0{\cdot}5N$ is required. The titration of iodine with sodium thiosulphate produces tetrathionate quantitatively even in very acid solutions ($6N$HCl) if the ionic concentration of the iodine is kept at a minimum. If potassium thiocyanate is used, the titration can be conducted in the presence of air, since the concentration of iodine is so low that the error due to its oxidation may be considered negligible.

CHEMICAL ABSTRACTS.

Estimation of Iodic Acid and Silver by Electrometric Titration. W. S. HENDRIXSON (*J. Amer. Chem. Soc.*, 1921, **43**, 858—866. Compare this vol., ii, 273).—The estimation of iodates and silver by the electrometric method previously described has been investigated. It is shown that iodate may be accurately estimated by reducing it with an excess of a known iodide solution in dilute sulphuric acid and titrating the excess with potassium permanganate electrometrically. Iodide can be titrated directly with iodate in dilute sulphuric acid solution by the electrometric method. Hydrochloric acid may not be substituted for sulphuric acid except within very narrow limits of concentration in the estimation of iodide with either potassium permanganate or iodate. These estimations may be made in the presence of chloride not exceeding about 0·1*N* or in the presence of nitric acid of higher concentration if it contains only traces of nitrous acid. Silver may be accurately estimated electrometrically with pure iodide and permanganate solution. Pure silver may be used as a standard in determining the values of both iodide and permanganate.

J. F. S.

Assay of Fluorides. Modification of Starck and Thorin's Method. EDUARDO D. GARCÍA (*Anal. Soc. Quím. Argentina*, 1920, **8**, 321—324).—Starck and Thorin's method (A., 1912, ii, 295) for the estimation of fluorides in aqueous solution is modified, whereby the excess of calcium in the filtrate from the mixed precipitate of calcium oxalate and calcium fluoride is estimated volumetrically. Knowing the amount of calcium required for the calcium oxalate, the amount of calcium fluoride and, hence, the percentage of fluorine in the original solution, is obtained. Insoluble fluorides are first fused with silica and sodium carbonate. After treatment of the mass with water, silica is removed by ammonium carbonate and fluorine estimated as above.

G. W. R.

Nitrogen Titratable by the Kjeldahl Method. W. MESTREZAT and (MLLE) MARTHE PAUL JANET (*Bull. Soc. Chim. Biol.*, 1921, **3**, 105—130).—A review with bibliography. G. B.

Detection of Nitric Acid. G. G. LONGINESCU and GABRIELA CHABORSKI (*Bull. Acad. Sci. Roumaine*, 1920, **6**, 176—178).—The characteristic odour of nitrobenzene is obtained when a nitrate is heated with a few drops of benzene and concentrated sulphuric acid; if bromides or iodides are also present, it is necessary to neutralise the heated mixture with sodium hydroxide before the odour of nitrobenzene can be noticed. W. P. S.

Estimation of Inorganic Phosphate in Urine by Alkalimetric Titration. CYRUS H. FISKE (*J. Biol. Chem.*, 1921, **46**, 285—295).—The author calculates a titration curve for centimolar mono-potassium phosphate (acid or alkali % plotted against P_H) and applies this to the determination. A volume of urine containing

2—7 mg. of inorganic phosphorus is precipitated with magnesium citrate and ammonia; the precipitate is collected in a glass tube containing a paper pad, is then dissolved in excess of acid, and titrated with $N/10$-alkali hydroxide and methyl-red until the colour matches that given by a standard acetate mixture.

G. B.

Electrically Heated Arsenic Reduction Tube. K. Zwicknagl (*Chem. Zeit.*, 1921, **45**, 418).—The tube is of the usual shape used with the Marsh apparatus, but the portion which is heated is flattened so that the passage for the gases is about 2 mm. wide; the latter are thus brought into closer contact with the heated wall of the tube. The heating is effected by a resistance wire wound round this part of the tube. W. P. S.

Clinical Method for the Quantitative Estimation of Potassium in Small Amounts of Serum. Benjamin Kramer and Frederick F. Tisdall (*J. Biol. Chem.*, 1921, **46**, 339—349).—The sodium cobaltinitrite method (A., 1920, ii, 268) can be used directly on undiluted serum without ashing; the precipitate is oxidised with excess of permanganate, excess of sodium oxalate is added, and this is titrated back with permanganate. One c.c. of serum is required; the error does not exceed 5% of the total potassium present; added potassium is recovered quantitatively. G. B.

New Methods for the Estimation of Potassium and Ammonium. O. Arrhenius (*Medd. K. Vetenskapsakad. Nobel-Inst.*, 1920, **4**, No. 6, 1—5).—Potassium is determined in soil analysis as follows. The material is freed from all metals except sodium and potassium, the solution made up to 15 c.c., acidified with 5 c.c. of glacial acetic acid, and cooled to 0°. Five c.c. of freshly prepared 10% sodium cobaltinitrite solution prepared according to Biilmann's description (A., 1900, ii, 624) are added and the precipitate is allowed to settle in the cold for about twelve hours. Most of the clear solution is decanted off and the precipitate transferred to centrifuge tubes with capillary stems. The last traces of precipitate are washed into the tubes with a little mother-liquor. The tubes are centrifuged until the height of the precipitate in the capillaries becomes constant. The height is read off by a scale on a mirror and compared with standards. The estimation of 0·01—0·02 mg. of potassium in 20 c.c. of solution is possible. The results are not affected by relatively large amounts of sodium salts.

The method of Folin and Macallum (A., 1912, ii, 683) for the estimation of ammonium is not accurate unless a saturated salt solution is used to suspend the soil. A solution of 0·5 gram of sodium sulphate and 2 c.c. of water is prepared in a test-tube. The weighed sample of soil is added and vigorously shaken. One to two c.c. of saturated sodium hydroxide solution are added and a few drops of petroleum. The tube is connected with an absorption flask containing standard acid, and air is aspirated through the solution to carry over the ammonia. A slow stream of air is used at first, but is increased later and continued for fifteen to twenty

minutes. The sample should not contain more than 1 mg. of ammonia. Higher nitrogen compounds are not attacked, but adsorbed ammonia is recovered. J. R. P.

The Estimation of Sodium in Blood. EDWARD A. DOISY and RICHARD D. BELL (*J. Biol. Chem.*, 1921, **45**, 313—323).—The method devised by Ball (Trans., 1910, **97**, 1408) may be modified for work with blood. The modifications are described in detail, and the estimation may be gravimetric, volumetric, or colorimetric. J. C. D.

Water Analysis. L. W. WINKLER (*Zeitsch. angew. Chem.*, 1921, **34**, 143).—Directions are given for the estimation of hardness, and of calcium and magnesium in water. Soap solution for use in the estimation of hardness may be prepared by neutralising palmitic acid or oleic acid with potassium hydroxide, propyl alcohol being used as the solvent. W. P. S.

The Volumetric Estimation of Zinc. I. M. KOLTHOFF and J. C. VAN DIJK (*Pharm. Weekblad*, 1921, **58**, 538—553).—The estimation by titration with acid is simple, but does not give good results, owing to the precipitation of basic salts instead of zinc hydroxide. The estimation may be carried out indirectly by passing hydrogen sulphide into the solution for thirty minutes in presence of ferrous salts, and titrating the liberated acid with borax, but accurate results are obtained only under narrow conditions of concentration of the zinc and iron.

Treadwell's titration with potassium cyanide in presence of ammonium salts gives good results, the ammonium salt apparently causing the zinc cyanide to separate in a colloidal form which dissolves readily in the excess of cyanide. The mercury double thiocyanate method, however, gives the best results, but chlorides must be absent. An excess of the thiocyanate solution, prepared from 1 mol. of mercuric nitrate and 4 mols. of potassium thiocyanate, is added to the zinc solution, the whole made up to a known volume and filtered, and the excess determined in an aliquot part by means of mercuric nitrate in presence of iron alum. If the concentration of the zinc is below $0{\cdot}01N$, the solution must be left a day before filtering. S. I. L.

Separation of the Metals of the Second Group. G. G. LONGINESCU and G. P. THEODORESCU (*Bull. Acad. Sci. Roumaine*, 1920, **6**, 159—164).—The precipitated mixed sulphides are heated with 10% ammonium carbonate solution, which dissolves the arsenic sulphide; the insoluble sulphides are then dissolved in hydrochloric acid with the addition of potassium chlorate, the solution is diluted, and the lead chloride separated by filtration. The filtrate is treated with sodium carbonate, then with sodium hydroxide, heated, and filtered. The insoluble portion contains the mercury, copper, bismuth, and cadmium, whilst the filtrate contains the tin, antimony, and a small quantity of lead. The precipitate is dissolved in hydrochloric acid, and the solution rendered

ammoniacal; mercury and bismuth are precipitated and the copper and cadmium remain in solution, and these four metals may then be separated and identified in the usual way. The filtrate containing the tin, etc., is treated with sulphuric acid to precipitate the lead, and, after the lead sulphate has been separated by filtration, the tin and antimony are identified in the filtrate. W. P. S.

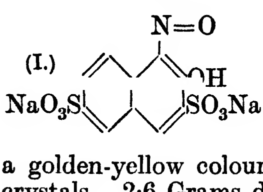
Trihalogen-Methyl Reactions. III. The Use of the Silver Cathode in Electro-deposition of Copper. HOWARD WATERS DOUGHTY and BENJAMIN FREEMAN (*J. Amer. Chem. Soc.*, 1921, **43**, 700—704. Compare A., 1918, i, 57; A., 1919, i, 513).—The authors describe a method for the removal of the copper deposit formed on silver cathodes used in the electro-deposition of this metal. It is shown that an ammoniacal solution of ammonium trichloroacetate dissolves copper, cadmium, and zinc with great ease; it dissolves nickel very slightly, but has no action on silver. In the case of copper, the reaction is strongly exothermic, as is shown by the following example. To a cold solution of 32 grams of trichloroacetic acid in 100 c.c. of ammonia (D 0·90), 19 grams of copper foil were added. The metal was entirely dissolved in six minutes, and the temperature rose from 13° to 105° during the process. The silver electrode is cleaned before use by placing in contact with pure tinfoil in boiling 10% sodium hydroxide solution until quite bright. It is then washed with dilute hydrochloric acid, then with dilute aqueous ammonia, and finally with distilled water. It is rinsed with alcohol, the alcohol ignited, and allowed to burn off. The electrolysis of copper from nitric acid solution is carried out just as is customary when a platinum cathode is used, except that the current must be switched on before the silver cathode is placed in the solution. After the final weighing, the cathode is placed in a wide-mouthed stoppered bottle filled with a 10% solution of trichloroacetic acid in aqueous ammonia (1 part of ammonia D 0·90 and 1 part of water). The copper is removed in about ten minutes, the cathode is then washed and dried as described above. Instead of using trichloroacetic acid, chloroform or carbon tetrachloride may be employed, but in this case the ammonia solution must be made from 1 part of ammonia D 0·90 and 1 part of alcohol. If carbon tetrachloride is used, care must be taken to ascertain that it contains no sulphur compounds. The reaction with both carbon tetrachloride and chloroform is much slower than that with trichloroacetic acid. J. F. S.

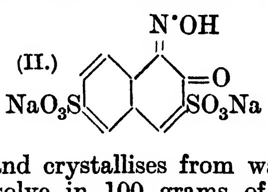
Estimation of Iron by the Cupferron Method. G. E. F. LUNDELL (*J. Amer. Chem. Soc.*, 1921, **43**, 847—851).—The estimation of iron by cupferron has been investigated. It is shown that the precipitation of iron by cupferron is quantitative in hydrochloric or sulphuric acid solutions containing as much as 20% by volume of either acid. The cupferron precipitate of iron is not dissolved by cold dilute hydrochloric acid (1 : 9) wash-water. Ammoniacal wash-waters, which need rarely be employed, may cause losses. These are always indicated by the formation of turbid filtrates. Crystal-clear filtrates and washings are absolutely

essential in accurate estimations of iron by the cupferron method. Cupferron precipitates of iron occasionally exhibit the tendency to creep through the filter. Consequently, when the filtrate or wash-water is even opalescent, the need for such corrective treatments as refiltration or digestion in the cold followed by refiltration is indicated. J. F. S.

Estimation of Iron in Wines. L. MATHIEU (*Ann. Chim. anal.*, 1921, **3**, 106. Compare Malvezin and Rivilland, this vol., ii, 351).—If the ash of the wine is dissolved in 10% sulphuric acid and the solution oxidised by heating with a drop or two of nitric acid, the iron may be estimated colorimetrically by means of potassium thiocyanate. This method is trustworthy and sensitive. W. P. S.

Nitroso-R-Salt. A New Reagent for the Detection of Cobalt. H. S. VAN KLOOSTER (*J. Amer. Chem. Soc.*, 1921, **43**, 746—749).—The methods of preparation and use of a reagent for the detection of cobalt are described. The reagent is prepared by dissolving 35 grams of pure R-salt (sodium β-naphthol-3 : 6-disulphonate) in 400 c.c. of water, acidifying with 10 c.c. of hydrochloric acid (D 1·19), cooling to 8—10°, and running in 7·2 grams of sodium nitrite in 20 c.c. of water drop by drop in the course of thirty minutes. The solution must be continuously stirred, and after a time an orange-yellow precipitate begins to form. The thick paste eventually formed is filtered and the cake obtained worked up with water and again filtered and washed with water and alcohol. The compound is either a nitroso-compound (I) or an oximino-compound (II); it has

(I.)


(II.)


a golden-yellow colour and crystallises from water in fan-shaped crystals. 2·6 Grams dissolve in 100 grams of water at 18°. It is very stable and may be kept indefinitely; its aqueous solution is also quite stable when kept in stoppered bottles. It forms a green compound with ferrous salts, a brownish-yellow compound with nickel salts, and a deep red dye with cobalt salts which has the composition $(C_{10}H_5O_8NS_2Na_2)_3Co$. The formation of this red dye serves as a very sensitive test for cobalt, although the presence of nickel and other metals which form coloured ions affects the sensitiveness, but if the test is conducted as follows 1 part of cobalt in 200 parts of nickel can be detected readily. To 2 c.c. of a dilute solution of the salt to be tested (1·5—2 grams in 100 c.c. of water) is added 1 gram of sodium acetate and 2 c.c. of nitroso-R-salt solution (0·5 gram in 100 c.c. of water). The liquid is boiled over a small flame, and after the gradual addition of 1 c.c. of nitric acid (D 1·4) the boiling is continued for at least one minute. A permanent change in colour toward red indicates the presence of cobalt. The colours produced by the other metals are destroyed by the nitric acid.

It is essential that the original solution should not be acid, for this retards and may prevent the formation of the red coloration.

J. F. S.

Estimation of Tin in Cassiterite. HÉRCULES CORTI (*Anal. Assoc. Quím. Argentina*, 1921, 9, 44—53).—The method proposed is a modification of that of Fresenius. The material under examination is fused with a mixture of sulphur and sodium carbonate. The fused mass is extracted with water, and stannic sulphide precipitated by dilute hydrochloric acid. The stannic sulphide is dissolved in strong hydrochloric acid and after elimination of hydrogen sulphide, hydrated stannic oxide is precipitated by addition of ammonia solution. This is collected and, after drying and ignition, weighed as stannic oxide. [See further *J. Soc. Chem. Ind.*, 1921, June.]

G. W. R.

The Chemical Examination of Antimony Sulphides. A. VAN ROSSEM and P. DEKKER (*India-rubber J.*, 1920, **60**, 905).—The estimation of free sulphur in antimony sulphides by extraction with organic solvents is impracticable, owing to the instability of the pentasulphide. In the absence of the trisulphide, the reaction $Sb_2S_5+6HCl=2SbCl_3+3H_2S+2S$ is employed, the amount of hydrogen sulphide liberated being a measure of the antimony pentasulphide; the residual sulphur less that produced in the reaction is the free sulphur present in the sulphide. Weber's method of estimation of free sulphur is untrustworthy unless barely ammoniacal solutions are employed. The methods of Weber and Sweet and of Repony for the estimation of moisture and water of crystallisation are revised.

CHEMICAL ABSTRACTS.

Electrolytic Estimation of Gold and its Separation from Copper, Palladium, and Platinum. W. D. TREADWELL (*Helv. Chim. Acta*, 1921, 4, 364—374).—Gold may be electrolytically deposited, rapidly and quantitatively, from solutions of its chloride containing acetate; this method admits of the separation of gold from copper, palladium, and platinum. The readiness with which palladium is attacked in comparison with platinum when subjected, in hydrochloric acid solution, to anodic polarisation serves as a means for the approximate estimation of the palladium content of a precipitate composed of a large proportion of palladium and of a little platinum.

T. H. P.

Combustions with Tellurium Dioxide. TH. R. GLAUSER (*Zeitsch. angew. Chem.*, 1921, **34**, 154—155; 157—159; 162—163. Compare A., 1914, ii, 216).—A further description of the use of tellurium dioxide in the determination of carbon and nitrogen by combustion. In the case of ferrosilicon, carborundum, etc., the reaction is very slow and for such substances lead oxide, or a mixture of lead oxide and tellurium dioxide, should be used.

W. P. S.

Examination of Urine containing Pentoses. ED. JUSTIN MUELLER (*J. Pharm. Chim.*, 1921, **23**, 317—321).—A urine examined

by the author was optically inactive, but reduced Fehling's solution, and when heated with hydrochloric acid yielded reactions for furfuraldehyde when tested with orcinol or phloroglucinol; pentoses were evidently present. Attention is directed to the fact that the presence of scatole or indoxyl pigments in urine interfere seriously with the above tests for furfuraldehyde. W. P. S.

The Estimation of Blood Sugar. ERIC PONDER and LAURENCE HOWIE (*Biochem. J.*, 1921, **15**, 171—174).—A micro-method for the estimation of sugar in blood is described, which is based on the method of Folin and Wu (A., 1919, ii, 308). The use of the torsion balance is avoided by measurement of the blood in a 0·2 c.c. pipette. C. R. H.

The Iodometric Estimation of Copper and its Use in Sugar Analysis. I. Equilibria in the Reaction between Copper Sulphate and Potassium Iodide. P. A. SHAFFER and A. F. HARTMANN (*J. Biol. Chem.*, 1921, **45**, 349—364).—Both cupric and cuprous salts may be estimated by means of the reversible reaction with iodine $Cu^{++}+2I^{1} \rightleftharpoons Cu^{+}+I_2$. The position of equilibrium has been determined for the reaction between copper sulphate and potassium iodide at ratios of from 1 to 10 of iodide to 1 of sulphate.

For determination of cupric salts, potassium iodide must be added to give a final concentration of about 0·25 *M*.

For the estimation of cuprous salts, the solution must be so diluted that the final concentration of copper and iodide does not exceed about 5 millemolar proportions each.

The conditions found empirically by Gooch and Heath for cupric salts (A., 1907, ii, 720) and by MacLean (A., 1916, i, 613) and Scales for cuprous salts (A., 1916, ii, 117) comply with these requirements. J. C. D.

The Iodometric Estimation of Copper and its Use in Sugar Analysis. II. Methods for the Determination of Reducing Sugars in Blood, Urine, Milk, and other Solutions. P. A. SHAFFER and A. F. HARTMANN (*J. Biol. Chem.*, 1921, **45**, 365—390).—Methods are outlined whereby the iodometric estimation of cupric or cuprous salts under the conditions laid down in a previous study (see preceding abstract) may be applied to the estimation of sugars in biological fluids. J. C. D.

The Iodometric Estimation of Sugars. JULIAN LEVETT BAKER and HENRY FRANCIS EVERARD HULTON (*Biochem. J.*, 1920, **14**, 754—766).—The authors confirm the opinion of Judd (A., 1920, ii, 395) that the method of Willstätter and Schüdel (A., 1918, ii, 337) gives good results. Certain practical details are given. It is essential that the reacting solutions should be mixed in the order sugar, iodine, alkali. The time required for the oxidation may be reduced to three or five minutes without affecting the accuracy of the method. Normal values were obtained with lactose, which does not support the suggestion of Judd that this sugar is first hydrolysed, and that both the dextrose and galactose molecules

are oxidised. The method was applied to the analysis of the products of the action of diastase on starch, and it was found that iodine does not differentiate between free maltose and that supposed to exist as "maltodextrin." When starch conversion products are fractionated with alcohol, the iodine values agree with the apparent maltose content as found by Fehling's solution.

J. C. D.

Inversion-constants for the Clerget–Herzfeld Method. FR. HERLES (*Z. Zuckerind. Cechoslov.*, 1921, **45**, 223—225).—Herzfeld's well-known formula, giving the inversion-constants for different concentrations of sucrose hydrolysed under the Clerget–Herzfeld conditions, has been confirmed and extended to include corrections for errors arising from the presence of mineral matter in molasses and from the use of basic lead nitrate (Herles's reagent) for clarification. J. H. L.

Estimation of Sucrose by the Inversion Method. V. SÁZAVSKY (*Z. Zuckerind. Cechoslov.*, 1921, **45**, 227—229, 235—238). —Sugar or molasses solutions may be clarified for polarisation and inversion by treatment with a 6% solution of tannin followed, after the liquid has been shaken, by addition of about an equal volume of basic lead acetate solution. The decolorising action, due to the precipitation of lead tannate, is greater than can be attained with basic lead acetate alone, and no error arises from the optical activity of the tannin, as the latter is completely precipitated. The author recommends Stanek's method (A., 1914, ii, 586) of taking the polarimetric readings, before and after inversion, in presence of free citric acid. J. H. L.

New Method for Detecting Lactic Acid in Gastric Juice or Other Organic Fluids. EMILIO PITTARELLI (*Bull. Acad. med.*, 1920, **84**, 132—135).—The test liquid is rendered neutral by addition of a saturated solution of magnesium sulphate, then mixed with permanganate solution, allowed to remain for two to three hours, and filtered. The lactic acid is oxidised to acetaldehyde, which is detected in the filtrate by the development of a red coloration on addition of phenylhydrazine hydrochloride, diazosulphanilic acid, and alkali hydroxide. A sensitiveness of 1 in 70,000 is claimed for the colour reaction. The only substances other than lactic acid likely to be encountered which give the reaction are ethyl alcohol and mannitol. CHEMICAL ABSTRACTS.

Estimation of Ethyl Acetoacetate. HIDEKICHI YANAGISAWA and MASUMI KAMIO (*J. Pharm. Soc. Japan*, 1921, 240—246).—Ethyl acetoacetate (3 mols.) reacts with sodium sulphite, liberating sodium hydroxide (2 mols.). The nature of the reaction is not clear, but it can be utilised for the estimation of the ester: 25 grams of crystallised sodium sulphite are dissolved in water and made up to 100 c.c., 50 c.c. of which are neutralised with N-sulphuric acid (say C c.c.). Five c.c. of a dilute alcoholic solution of the ester

(about 10%) are shaken vigorously with the remaining 50 c.c. of the sodium sulphite solution and the liberated alkali is titrated with N-sulphuric acid (A c.c.), using phenolphthalein as indicator. Five c.c. of the 10% solution of the ester are diluted with 20 c.c. of water and any free acid in the sample is titrated with N-sodium hydroxide (B c.c.). The number of c.c. of N-sulphuric acid used for the neutralisation of the liberated alkali would be given by $A+B-C$; 1 c.c. of N-sulphuric acid corresponds with 0·1952 gram of pure acetacetic ester. Acetone can also be estimated by the same method. K. K.

Mercurometric Estimation of Oxalic Acid. ARTHUR ABELMANN (*Ber. Deut. pharm. Ges.*, 1921, **31**, 130—131).—To the oxalic acid or oxalate solution in a 100 c.c. flask 30—40 drops of $5N$-nitric acid and an excess of $N/10$-mercuric nitrate solution, containing sufficient nitric acid to produce a clear solution, are added, followed by about 50 c.c. of saturated chlorine-free potassium nitrate solution and sufficient water to make 100 c.c. After keeping for fifteen minutes, the liquid is filtered and an aliquot portion of the filtrate titrated with $N/10$-ammonium thiocyanate, using ferric ammonium sulphate as indicator. G. F. M.

The Determination of the Acetyl Value of Fatty Substances. ÉMILE ANDRÉ (*Compt. rend.*, 1921, **172**, 984—986).—The saponification value, S, of the fatty substance and the saponification value, S_1, of the same substance after acetylation are determined. Then the acetyl value of the fatty substance is given by

$$S_1-S[1+\lambda S/(1-\lambda S)],$$

where $\lambda=0·75$. The value of λ is arrived at by dividing the increase in molecular weight of a monohydric alcohol on acetylation (59—17) by the molecular weight of potassium hydroxide. The acetyl values obtained by this method are always slightly less than those obtained by the method of Lewkowitsch (A., 1890, 72, 91; 1897, ii, 316). W. G.

A New Rapid Method for Detecting Albumoses and Peptones in Urine. EMIL HUGO FITTIPALDI (*Deut. Med. Woch.*, 1920, **47**, 42; from *Chem. Zentr.*, 1921, ii, 478).—A mixture of 2 c.c. of 5% nickel sulphate solution with strong ammonia (D 0·92) is added to 4—5 c.c. of urine made strongly alkaline with potassium hydroxide. In presence of protein, a white or greenish-white ring is formed. An orange-yellow ring is given in the presence of albumoses and peptones. G. W. R.

Use of Edestin in Determining the Proteolytic Activity of Pepsin. J. F. BREWSTER (*J. Biol. Chem.*, 1921, **46**, 119—127).—A modification of the method of Fuld and Levison (A., 1908, ii, 76), together with a method for preparing crystalline edestin from hemp seeds. After mixing various amounts of 1% edestin and 0·1 N-hydrochloric acid solutions with equal amounts of 10% sodium chloride in a series of tubes, equal amounts of 1% pepsin are added and the time noted which is necessary to produce a clear solution. G. B.

Iodometric Estimation of the Diastatic Power of Malts. JULIAN L. BAKER and HENRY F. EVERARD HULTON (*Analyst*, 1921, **46**, 90—93).—The maltose formed by the action of malt on starch is oxidised to maltobionic acid by the action of iodine in alkaline solution, the amount of iodine required for the oxidation being a measure of the quantity of maltose present. One, 2, or 3 c.c. of the malt extract are added to 100 c.c. of 2% soluble starch solution, the mixture is kept at 21° for one hour, 10 c.c. of $N/10$-sodium hydroxide are then added, and the whole is diluted to 200 c.c. Fifty c.c. of this solution are treated with 20 c.c. of $N/10$-iodine solution and 30 c.c. of $N/10$-sodium hydroxide solution; after ten minutes, 4 c.c. of $N/1$-sulphuric acid are added and the excess of iodine is titrated with $N/10$-thiosulphate solution. Under these conditions, the diastatic power of the malt equals $16{\cdot}7Y/X$, where Y is the number of c.c. of $N/10$-iodine solution used for the oxidation and X the number of c.c. of 5% malt extract taken for the conversion. W. P. S.

Chemistry of Neoarsphenamine [Neosalvarsan] and its Relation to Toxicity. GEORGE W. RAIZISS and M. FALKOV (*J. Biol. Chem.*, 1921, **46**, 209—221).—Analysis of three commercial samples, particularly as regards the distribution of the sulphur. A low arsenic content may be due to the presence of uncombined sodium formaldehyde sulphoxylate, sulphate, or chloride. The arsenic: nitrogen ratio equals the theoretical in good samples, and may be taken as an index of purity. The amount of iodine necessary for complete oxidation is in excess of that required merely by arsenic; this is attributed to uncombined sulphoxylate; sulphoxylate combined with the amino-group does not react with iodine. The amount of combined sulphoxylate indicates that the samples were mixtures of mono- and di-substituted products. G. B.

Examination of Neoarsphenamine [Neosalvarsan]. A. DOUGLAS MACALLUM (*J. Amer. Chem. Soc.*, 1921, **43**, 643—645).—The degree of purity of neoarsphenamine (neosalvarsan) is best estimated by determining the sulphoxylate group ($\cdot CH_2 \cdot O \cdot SONa$), as the difference between the total reducing power towards iodine and that due to free reducing substances and arsenic, according to a procedure which is detailed. In the best preparations the ratio sulphoxylate group : arsenic approximates closely to the value 1 : 2, although it is not possible exactly to attain this value.

J. K.

General and Physical Chemistry.

The Variation of the Specific Refraction of Salts dissolved in Dilute Solutions. C. Chéneveau (*Compt. rend.*, 1921, **172**, 1408—1410).—It has been shown previously (A., 1910, ii, 365) that the specific refraction $(n_D-1)/d$, of a dissolved salt is constant for solutions down to a dilution equal to $N/10$. It is now shown that at extreme dilutions the refractive power may diminish or increase, according to the salt used, when the concentration decreases. Results are plotted for magnesium nitrate, potassium chloride, and ammonium nitrate, and it is seen that, in very dilute solutions, the value of $(n_D-1)/d$ decreases with the pressure of the dissolved substance for the two substances first named but increases as the pressure decreases in the case of ammonium nitrate. These results are to some extent in accord with those of Posejpal for gases (*J. Physique*, 1921, [vi], **2**, 85). W. G.

Pole Effect in the Arc Spectrum of Manganese. Sophie Brendel-Wirminghaus (*Zeitsch. wiss. Photochem.*, 1921, **20**, 229—256).—The arc spectrum of manganese has been measured in the ultra-violet over the range λλ 3130—3600 and in the greenish-yellow over the range λλ 4700—5600 with the object of ascertaining whether manganese exhibits the pole effect which has been observed in the case of calcium. Measurements were made with the light from the positive pole, the negative pole and the centre of the arc. The author is unable to detect any displacement of the lines; the wave-lengths of the lines measured in the three regions are identical within the limits of experimental error. Changing the current from 6 to 10 amperes has no effect on the position of the lines. It is therefore concluded, since the pole effect previously described is only shown by the less well-defined lines, that there is no real displacement of the lines, the effects observed being merely a broadening of unsymmetrical lines. J. F. S.

The Measurement of Rotatory Power in Biaxial Crystals. Louis Longchambon (*Compt. rend.*, 1921, **172**, 1187—1189).—An arrangement of apparatus is described for measuring the rotatory power in biaxial crystals, under conditions approximating as nearly as possible to the theoretical solution of the problem as given by Pocklington (*Phil. Mag.*, 1901, [vi], **2**, 361). In this way, the author has been able to measure the rotatory power of strontium formate, obtaining the value 7° 30′ for a radiation of $\lambda=0{\cdot}579\mu$. W. G.

The *L*-Series of Uranium and the Principle of Combination in *X*-Ray Spectra. A. Dauvillier (*Compt. rend.*, 1921, **172**, 1350—1353).—The L_1 series of uranium photographed alone with very long exposures shows, in addition to the rays l, α_2, α_1, β_6, β_2,

β_7, and β_5, two new satellites of β_2, namely, $\beta'_2=754{\cdot}1\times10^{-11}$ cm. and $\beta''_2=747\times10^{-11}$ cm. If the L_1 series and its discontinuity of absorption are taken on the same plate, a very clear white ray (absorption ray) appears just beyond the discontinuity and having the same breadth as the emission rays. In the L_2 series only the rays η, β_1, γ_5, γ_1, γ_6, and γ_2 which give the L doublet of Sommerfeld were found. A new line, $\gamma_8=568{\cdot}9$, was found in the L_3 series, thus giving in this series the rays γ_8, γ_4, γ_3, γ_7, γ_9, β_8, β_9, β_3, and β_4.

W. G.

Magnetic Spectrum of the β-Rays Excited by γ-Rays. C. D. Ellis (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 261—271).—The magnetic spectrum of the β-rays excited by the γ-rays of radium-*B* in uranium, lead, platinum, tungsten, and barium has been measured. It is shown that the main lines are formed by electrons ejected from the *K* ring by definite γ-rays, each type of γ-ray being characterised by a certain energy. The magnetic spectrum of the β-rays of radium-*B* is accounted for on this basis. The magnetic spectrum of the low velocity β-rays of thorium-*D* has been measured and is explained in the same way as the radium-*B* β-ray spectrum. The wave-lengths of the γ-rays of radium-*B* are calculated, on the basis of the quantum theory, from the characteristic energies found. Evidence is adduced to show that the greater the energy of binding of an electron the greater is the probability of it absorbing this hard γ-radiation.

J. F. S.

Electron Velocities for the Production of Luminosity in Atmospheric Neon. Frank Horton and Ann Catherine Davies (*Phil. Mag.*, 1921, [vi], **41**, 921—940).—No luminosity is produced in neon as a result of the first type of ionisation, beginning at 16·7 volts. This suggests that the corresponding spectrum may consist entirely of lines outside the visible region. The fact that the combination principle applies without modification between some of the lines excited at 20·0 volts and some at 22·8 volts excludes the possibility that these correspond with two distinct elements. They must correspond with the removal of differently situated electrons from the neon atom, and lines as closely related as those of a principal and the corresponding subordinate series can arise from the return of electrons removed from different positions within the atom.

J. R. P.

Emission of Electrons under the Influence of Chemical Action. O. W. Richardson (*Phil. Trans.*, 1921, [*A*], **222**, 1—43). —The emission of electrons from the liquid alloys NaK_2 and NaK, when acted on by carbonyl chloride, chlorine, hydrogen chloride, and water vapour at very low pressures, was examined, the alloy being dropped through the gas. The current-potential curves resemble those found in thermoionic emission and are not inconsistent with a distribution of energy among the electrons corresponding with that applying to the molecules of a gas, according to Maxwell's law, at a temperature of about 3300° abs. in the case of carbonyl chloride, and about 4900° abs. in the case of chlorine. On

the assumption that the heat of reaction is given to one electron emitted, the energy of the latter would correspond with a temperature about fourteen times that calculated from the curves, which is taken to mean that the energy of reaction is divided among the atoms as well as the electrons. J. R. P.

Electrical Conduction of an Hydrogen Alloy. DONALD P. SMITH (*Proc. Nat. Acad. Sci.*, 1921, **7**, 28—34).—The conductivity of palladium charged with hydrogen has been measured at 25°, using different currents in the measurements. It is shown that the resistance varies with the current employed, and consequently the temporary supplementary conduction exhibited by metals during cathodic occlusion of hydrogen and for some time afterwards, is not to be regarded as metallic conduction. The results are in keeping with the hypothesis that the conduction is effected by a transient form of the occluded hydrogen, probably monatomic, and consists in a transport of electrical charges between points of different potential within the metal. The measuring currents employed in the present work were 4·2 and 2·1 milliampères, and it seems likely, with much larger measuring currents than these, that the supplementary conduction would approach a limiting value, owing to the inability of ordinary diffusion to maintain the concentration of hydrogen atoms in the regions from which these are driven by the current. Above this limit the dependence of resistance on current would not be observed. J. F. S.

Allotropic Varieties of Oxides. (MLLE) S. VEIL (*Compt. rend.*, 1921, **172**, 1405—1407).—The curve showing the variations in the conductivity of magnetic oxide of iron with temperature has a marked double inflexion approximately at the Curie point. This anomaly is only shown with rising temperature. It is possible that this is due to the formation of an allotropic modification of the oxide. The curve for cadmium oxide shows three points of inflexion and on the basis of these results the existence of three allotropic modifications, α, β, and γ, of this oxide is suggested. W. G.

The Limiting Value λ_∞ of Molecular Conductivity in Non-aqueous and Aqueous Solutions. P. WALDEN (*Zeitsch. anorg. Chem.*, 1921, **115**, 49—86).—The calculation of the limiting value of molecular conductivity in aqueous solutions was discussed by Lorenz (A., 1920, ii, 6), who compared the values obtained from the Ostwald-Bredig rule $\lambda_\infty = \lambda_v + d_v$, where d_v is a constant depending only on the dilution, with those obtained by the alternative Kohlrausch formulæ $\lambda_\infty = \lambda_v + a/v^{0·5}$ and $\lambda_\infty = \lambda_v + b/v^{0·33}$. He also showed that, for aqueous solutions of sodium chloride, the best results were given by the formula $\lambda_\infty = \lambda_v + b'/v^{0·45}$. The two formulæ containing $v^{0·5}$ and $v^{0·45}$ respectively have now been tested for non-aqueous solutions at 25°. The data chosen for the comparison included those relating to solutions of the typical binary iodides, sodium, potassium, tetramethyl, tetraethyl- and tetrapropyl-ammonium iodides in the following solvents: formamide,

formic acid, cyanoacetic ester, nitrobenzene, benzonitrile, acetophenone, ethyl alcohol, nitromethane, benzaldehyde, epichlorohydrin, methyl alcohol, acetonitrile, pyridine, propionitrile, and acetone.

From the values of λ_∞ calculated from the $v^{0 \cdot 45}$ formula, the values of d_v in the equation $\lambda_\infty = \lambda_v + d_v$ were calculated for each solvent for different dilutions, and it was found that the Ostwald-Bredig rule can be applied to all these solvents as well as to water through the range of dilutions from $v=256$ to 50,000. In the above list of solvents, these are placed in ascending order of the d_v values at each dilution, water coming between formic acid and cyanoacetic ester.

From general considerations it was deduced that the product $d_v \cdot \epsilon \cdot \eta_\infty$ should be constant at a particular dilution for all solvents, ϵ being the dielectric constant and η_∞ the internal friction. This deduction proved to be correct, and it was further found that by introducing the dilution factor $v^{0 \cdot 45}$ an expression was obtained which is general for all solvents and all solutes at all dilutions, namely, $K = d_v \cdot \epsilon \cdot \eta_\infty \cdot v^{0 \cdot 45}$. The mean value of this constant K for all the above solvents, including water, at all dilutions, was found to be 51·4, the divergences on either side from the mean being remarkably small. It follows that, when the values of ϵ and η_∞ are known for any solvent, d_v can be calculated for any dilution, and from a single observation of λ_v, λ_∞ can be calculated and hence $\alpha = \lambda_v / \lambda_\infty$. The general relation between d_v, ϵ, and η_∞ appears to hold for all temperatures.

It has been shown previously (this vol., ii, 160) that the product $\lambda_\infty \eta_\infty$ is a constant for all ionising solvents, independent of the temperature between 0° and 25°, but depending, within limits, on the nature of the solute. The above general expression can be transposed to the form

$$(1-\alpha)\epsilon \cdot v^{0 \cdot 45} = 51 \cdot 4 / \lambda_\infty \eta_\infty = \text{const.}$$

It follows from this that, if the product $\lambda_\infty \eta_\infty$ is known for a salt in any one solvent, its degree of dissociation in any other solvent at any dilution can be calculated.

When the values of d_v are calculated from Kohlrausch's $v^{0 \cdot 5}$ equation, the value of the constant $K' = d_v \cdot \epsilon \cdot \eta_\infty \cdot v^{0 \cdot 5}$ is 65·7. The numerical relationships between the values of λ_∞ deduced from the different formulæ have been calculated, and it is shown that $\lambda_\infty [v^{0 \cdot 45}] = 1 \cdot 0077 \lambda_\infty [v^{0 \cdot 5}]$. E. H. R.

A Variable Resistance. O. MAASS and C. H. WRIGHT (*J. Amer. Chem. Soc.*, 1921, **43**, 1179).—A variable resistance which has many advantages over a slide wire is described. The apparatus consists of a platinum wire (1 ohm per 50 cm.) which is held taut down the centre of a vertical glass tube (1—2 cm. diam.); the wire passes out of the tube at either end through cement seals. Near the base of the tube a side tube is sealed on which is connected to the bottom of a bulb of capacity greater than that of the tube. The bulb contains mercury, and as the tube containing the wire

is evacuated, any change of external pressure on the mercury in the bulb varies the height to which the mercury rises in the tube and so vary the resistance. The advantages of the apparatus are (1) the wire is maintained in a vacuum and consequently keeps a constant resistance, and (2) since the resistance is controlled by the applied pressure the resistance readings may be made directly from the pressure readings, which means that an accuracy of 0·002 ohm can readily be obtained. J. F. S.

Determination of the Electrical Resistance of Alloys of Lead–Tin and Lead–Zinc at High Temperatures. SEIBEI KONNO (*Sci. Rep. Tôhoku Imp. Univ.*, 1921, **10**, 57—74).—The electrical resistance of alloys of lead and tin and lead and zinc have been measured over the whole range of concentrations, both during heating and cooling, above and below their melting points. The temperature–resistance curves have been plotted, and from these the equilibrium diagrams of the alloys have been constructed. They are found to coincide almost exactly with those obtained by thermal analysis. The rate of separation of the solid solution during solidification has been calculated both from the resistance–temperature curves and from the equilibrium diagram, and the results obtained in the two cases show a good agreement. J. F. S.

Apparent Irreversibility of the Calomel Electrode. A. W. LAUBENGAYER (*J. Physical Chem.*, 1921, **25**, 332—336).—It has been shown by Paschen (A., 1890, 552) that a mercury anode polarises more strongly in hydrochloric acid than in sulphuric acid. This point has been investigated, and in preliminary experiments it is found that a mercury anode in hydrochloric acid becomes coated with a black film of an apparently high resistance. The potential drop for various currents has been measured for the following systems: Hg (anode) | *N*HCl | Pt (cathode); Hg (anode) | Hg_2Cl_2,*N*HCl | Pt (cathode): Hg (anode) | Hg_2Cl_2,*N*KCl | Pt (cathode): Pt (anode) | Hg_2Cl_2,*N*HCl | Pt (cathode); Hg (anode) | *N*H_2SO_4 | Pt (cathode); Hg (anode) | Hg_2SO_4,*N*H_2SO_4 | Pt (cathode): Pt (anode) | Hg_2SO_4,*N*H_2SO_4 | Pt (cathode). The results show that the apparent irreversibility of the calomel electrode is not real, but is due to the formation on the mercury anode of a strongly adsorbed film of mercurous chloride, which offers a high resistance to the passage of the current. If this is scraped off as fast as it is formed it becomes a simple matter to prepare calomel electrolytically at a relatively low voltage. J. F. S.

New Conceptions of Electrolytes. I. The Degree of Dissociation of Acetic Acid in Water and in Salt Solutions. ERLING SCHREINER (*Zeitsch. anorg. Chem.*, 1921, **115**, 181—201).—A theoretical paper in which formulæ are derived for correcting the dissociation constant, as ordinarily determined from conductivity measurements, for the viscosity of the solution, inter-ionic force, and the activity of the water, that is, the hydration of the hydrogen ion. The conductivity of acetic acid as determined by

different observers is thus corrected at 25° over the range of dilution from 0·0005 to 2·6 normal. The law of mass action is shown to hold up to the highest concentration. From potential measurements at 18° and 25° of acetic acid solutions containing sodium acetate or other salts, the activity of the acetate ion and the dissociation constant of acetic acid have been calculated. Such measurements do not, as has been generally supposed, determine the hydrogen-ion concentration, but the activity of the hydrogen ions, which is associated only with the non-hydrated ions. The dissociation constants of acetic acid calculated thus agree well with those calculated from the conductivity measurements. Taking the activity constant of the hydrogen ion as 0·2, that of the acetate ion is the same in sodium acetate solution and 0·3 in sodium and potassium chloride solutions. E. H. R.

New Method of Measuring Electrolytic Conductivity. CHARLES MARIE and W. ALBERT NOYES, JUN. (*J. Amer. Chem. Soc.*, 1921, **43**, 1095—1098).—A new method for measuring the electrical conductivity is described. The method consists in inserting two hydrogen electrodes of exactly equal potential in the solution in question and an ordinary direct current. A Wheatstone bridge is used to determine the resistance. Measurements of the equivalent conductivity of various acids and sodium chloride solutions have been made and negligible differences between the direct current values and the values found by Kohlrausch's method are found except for solutions above 0·5*N*-sulphuric and hydrochloric acid. J. F. S.

Dielectric Constants of Electrolytic Solutions. R. T. LATTEY (*Phil. Mag.*, 1921, [vi], **41**, 829—848).—Formulæ are deduced for the determination of dielectric constants of electrolytes by the condenser method. Anomalous absorption was not formed in the experiments. The circuit consisted of two receiving inductances, two variable condensers in series, and a thermal converter attached to a millivoltmeter. The following dielectric constants were determined:—Water 81·05 at 18°. Glycerol 51·15 (17—18°). Sucrose solutions: 6·84% 81·2 (13°), 11·92% 69·8 (14°), 20·6% 79 (16°). Potassium chloride 0·000755*N* 80·25 (15·4°), and 75·0 (15·4°); 0·00151*N* 77·7 (10·6°); 0·00755*N* 66·25 (16·8°). Cupric sulphate 0·00114*N* 75·2 (15·1°); 0·00228*N* 78·2 (13·2°); 0·00456*N* 73·9 (14·8°). Tetraethylammonium naphthalene-β-sulphonate 0·002*N* 76·3 (16·6°); 0·005*N* 69·0 (14°). The dielectric constant of water is independent of the frequency between wave-lengths of 17 and 52 metres. The electrolytes investigated appear to lower the dielectric constant of water and are analogous to the majority of non-electrolytes. J. R. P.

Electrical Conductivity in Solid Crystallised Compounds II. Transportation and Wandering of Ions in uniform Solid Electrolytes. C. TUBANDT (*Zeitsch. anorg. Chem.*, 1921, **115**, 105—126).—In a former paper (A., 1920, ii, 279) it was shown that the study of the electrolysis of solid crystalline salts was facilitated

by interposing between the cylinder of salt under examination and the platinum cathode a cylinder of cubic silver iodide. By this means, short-circuiting by the growth of a bridge of metal between the electrodes was prevented. The same device has been used in studying ionic migration in the electrolysis of silver bromide and chloride, lead chloride, lead fluoride, silver sulphide, and cuprous sulphide. To determine whether the current is carried by the positive or negative ion or by both, two or more carefully made compressed cylinders of the salt under examination, of known weight, were held by pressure between a silver anode and a platinum cathode, generally with a cylinder of silver iodide interposed between the last cylinder of the salt and the cathode. By weighing the separate cylinders before and after electrolysis, after allowing for the weight of silver taken up at the anode and deposited on the cathode, any transference of the negative element could be detected. With silver iodide, bromide, and chloride it was found that the current was carried entirely by the positive silver ion. In the case of silver iodide the migration velocity of the ion was, at 145°, $0{\cdot}55 . 10^{-3}$ cm. per sec., about the same value as in aqueous solutions at 18°, whilst at 552° the value was $1{\cdot}1 . 10^{-3}$. For silver bromide at 422° the velocity was $0{\cdot}15 . 10^{-3}$ and for silver chloride the highest value, close to the melting point, was $0{\cdot}03 . 10^{-3}$ cm. per sec. In the case of lead chloride, however, the current was entirely carried by the chlorine ion, the gain in weight of the lead chloride cylinder adjacent to the anode being exactly equivalent to the silver deposited on the cathode in the voltameter which was included in the circuit. In the case of lead fluoride also, the current was conveyed entirely by fluorine ions. Silver sulphide was found to be a true electrolytic conductor above 180°, the silver ions being the carriers with the high migration velocity of 0·11 cm. per sec. Difficulties were encountered in the experiments with cuprous sulphide, but sufficient evidence was obtained to show that the cubic form of this substance is a pure electrolytic conductor, the carriers being the positive cupro-ions. The fact that in some salts only the positive, in others only the negative ions, are mobile, may have a bearing on the lattice structure of these salts. E. H. R.

Activity Coefficient of Strong Electrolytes. GILBERT N. LEWIS and MERLE RANDALL (*J. Amer. Chem. Soc.*, 1921, **43**, 1112—1154).—A theoretical paper in which the various methods of determining the exact values of the activity coefficient (thermodynamic degree of dissociation) are discussed. It is shown that the activity coefficients of sodium chloride (0—6*M*), calculated from freezing points, agree with those calculated from electromotive force within a few tenths per cent., notwithstanding the fact that one term alone in the freezing-point equation, which involves the heat of dilution, affects some of the results by 20%. An even more extensive test of the several methods is furnished in the case of sulphuric acid, where satisfactory agreement is obtained over the range 0—20*M* (66% acid) by three different methods. Calculations of activity coefficients in mixtures, especially from the solubility of

salts in the presence of other salts, lead to an extremely useful and general rule based on the new conception of ionic strength. Each ion contributes to this ionic strength by an amount which is proportional to its stoicheiometrical molarity multiplied by the square of its valency. In accordance with this rule, the activity coefficient of every strong electrolyte (and the individual activity of every ion) is the same in all dilute solutions of the same ionic concentration. It therefore depends in no way on the number or the nature of the ions of which the solution is composed. J. F. S.

Constant Volume Explosion Experiments. S. LEES (*Proc. Camb. Phil. Soc.*, 1921, **20**, 285—290).—It has been suggested that the differences between the results for the specific heats of gases obtained by the explosion method and those found by heating at constant pressure might in part be due to the differences in temperature at any instant in different parts of the explosion vessel. These are shown by calculation to correspond with a correction of not more than 1% at 1600°, which is within the limits of experimental error. J. R. P.

The Specific Heat of Technical Copper-Zinc Alloys at Higher Temperatures. FR. DOERINCKEL and MAX WERNER (*Zeitsch. anorg. Chem.*, 1921, **115**, 1—48).—The specific heats of brasses containing 58%, 63%, 67%, 72%, and 85% of copper, and of pure copper, were determined at temperatures between 100° and 800° with the object of determining the influence of composition and of temperature on the specific heat. The water calorimeter method was used, and the determinations were made on both untempered and tempered alloys. In the case of the untempered alloys, when the mean specific heat was plotted against temperature, the curves showed a discontinuity characterised by a sudden rise in the specific heat in the neighbourhood of 470°. This discontinuity was most marked in the low copper alloys, small in the 72% and absent in the 85% copper alloy. In some cases, after tempering at 800°, the specific heat at 500° and 600° was lowered to such an extent that the discontinuity in the curve disappeared. The discontinuity may be due to the transition observed by Carpenter and Edwards at 470° from β-mixed crystals to α- and β-brass, but this explanation is not altogether satisfactory, since this transformation takes place very slowly. Owing to the contradictory character of some of the experimental results on the effect of tempering, it is assumed that the transition may be influenced in an indeterminate manner by small amounts of impurity present in the brass. The specific heat of the alloys increases with increasing content of β-mixed crystals.

The mean specific heat of tempered alloys is expressed by the linear equation $c_m=a+b(T-t)$, and the true specific heat by $c_w=a+2b(T-t)$, where a and b are constants and $t=20°$. For copper, $a=0{\cdot}0922$ and $b=0{\cdot}000011789$. As the proportion of zinc increases, a diminishes and b increases, and for brass containing 57·3% of copper, $a=0{\cdot}0895$ and $b=0{\cdot}00003354$. When the mean or true specific heat is plotted against per cent. copper, at constant

temperature, curves are obtained for each temperature showing the effect of copper concentration on the specific heat. In the α-mixed crystal region the variation of specific heat with copper concentration is practically linear at all temperatures; above 500°, the specific heat increases with decreasing copper concentration, whilst below 300° it decreases. At 65·81% of copper the curve shows a sudden change of direction as the copper concentration falls, the specific heat increasing rapidly at temperatures above 100°, the more rapidly the higher the temperature, and falling at temperatures below 100°. The change of direction of the curve corresponds with the saturation limit for α-mixed crystals at 64% copper. It is noteworthy that at temperatures near 100° there is practically no discontinuity in the specific heat–concentration curve, the specific heat remaining practically constant at all concentrations. By extrapolation of the curves to 53% copper, the saturation limit of β-mixed crystals, the specific heat of β-brass at temperatures from 100° to 800° was calculated. [See also *J. Soc. Chem. Ind.*, 1921, July.] E. H. R.

New Equation of State of Gases, Founded on a Knowledge of the Internal Pressures. A. LEDUC (*Compt. rend.*, 1921, **172**, 1167—1172).—A mathematical paper in which the author deduces the equation $[\pi+\tau/\nu^2(4^{1/\tau}-1)](3\nu-1)=8\tau$, from which it is seen that the interior pressure and the internal pressure tend towards the same limit log $4/N^2$. If this is applied to the calculation of the coefficient of dilatation, β, the value obtained for sulphur dioxide is 389×10^{-5}. W. G.

The Condition Diagram of Carbon. J. A. M. VAN LIEMPT (*Zeitsch. anorg. Chem.*, 1921, **115**, 218—224).—A theoretical paper in which the work of Lummer, Fajans (A., 1920, ii, 469), van Laar (this vol., ii, 17) and others on the temperature of the crater of the carbon arc at high and low pressures is discussed. The equation connecting temperature and pressure deduced by van Laar is the most satisfactory, whilst the accuracy of Lummer's observation of the appearance of liquid carbon below 4700° is open to serious doubt. E. H. R.

Comparison of Tammann's and Cuy's Theories of the Periodic Irregularities of Physical Properties in Homologous Series. EUSTACE J. CUY (*Zeitsch. anorg. Chem.*, 1921, **115**, 273—287).—Tammann's theory of the cause of the alternate higher and lower melting points in the successive members of the fatty acid series (A., 1920, ii, 285) is based on the single observation that acetic acid is dimorphous whilst formic acid is not. Many other physical properties show the same kind of alternation in homologous series, and it is shown that generally, when the numerical value of the property is plotted against the number of carbon atoms, the points corresponding with an even number of carbon atoms lie on one smooth curve and those corresponding with an odd number on another. The melting points of the paraffin hydrocarbons are a case in point. Here, although the melting points do not alternately

rise and fall, the melting point differences between successive members of the series are alternately larger and smaller. Other examples of alternation are furnished by the melting points of the glycols and $\alpha\alpha'$-diamines, solubilities in the oxalic acid series, molecular rotations in the amyl esters of normal fatty acids, and boiling points of normal aldehydes, *cyclo*methylenes and acetic esters of normal alcohols. All these phenomena can be explained by Cuy's theory of the alternate positive and negative character of carbon atoms in a normal carbon chain (A., 1920, i, 361). On this theory the addition of one positive or negative carbon atom changes considerably the electronic character of the chain, whilst the addition of two links, one positive and one negative, preserves the general electronic character. Alternation of physical properties in normal chain series is therefore to be expected. E. H. R.

Periodic Irregularities of Physical Properties in Homologous Series. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1921, **115**, 288—289).—A brief reply to Cuy (previous abstract). E. H. R.

Effect of Finely Divided Material on the Freezing Points of Water, Benzene, and Nitrobenzene. F. W. PARKER (*J. Amer. Chem. Soc.*, 1921, **43**, 1011—1018).—The freezing point of water, benzene, and nitrobenzene in the presence of finely divided ferric hydroxide, alumina, silica, and Carrington silt loam has been determined by the method described by Bouyoucos and McCool (A., 1917, i, 510; 1919, i, 115). The results indicate that finely divided material causes a depression of the freezing point of a liquid when the liquid exists in the film or capillary condition in the solid material. The depression of the freezing point due to the solid material and that due to material in solution are additive. The concentration of the soil solution cannot be measured by the freezing-point method except at very high moisture content. The significance of the lowering of the freezing point by finely divided solid material to the behaviour of moist living tissue at low temperatures is indicated. J. F. S.

Freezing Points of Organic Substances. III. JEAN TIMMERMANS (*Bull Soc. chim. Belg.*, 1919, **28**, 392—402. Compare A., 1911, ii, 854; 1914, ii, 168).—Organic compounds obey a law of convergence in that the melting points of the higher terms of all the homologous series tend towards a common limit of 117°. There are, however, certain series which do not obey this law, but they are considered as constituted by substances with particular structures, such as the amino-acids, substances containing two amide groups or an analogous group. It results from the above law that, for the higher members of a series, physical constants such as the melting point are not a criterion for differentiating one homologue from another. W. G.

Freezing Points of Organic Substances. IV. New Experimental Determinations. JEAN TIMMERMANS (*Bull. Soc. chim. Belg.*, 1921, **30**, 62—71).—The freezing points of a further 94 specially purified organic liquids were determined (compare

preceding abstract) at temperatures ranging from $-187.8°$, the freezing point of propane, upwards. The results are expressed in tabular form in the original paper. G. F. M.

Freezing Points of Organic Substances. V. The Odd and Even Alternation and the Lowest Melting Point in a Homologous Series. JEAN TIMMERMANS (*Bull. Soc. chim. Belg.*, 1921, **30**, 89—97).—A theoretical paper in which the author discusses the relationship between melting points and spatial structure of the molecule. He shows that the linear structure of open carbon chains as postulated by Hinrichs (*Compt. rend.*, 1891, **112**, 998; A., 1891, 1330, 1441) is in accord with the experimental facts as to the melting points of members of homologous series. The alternation of melting points between the odd and even members of a series is a general phenomenon, the odd members melting lower than the even members in series where the molecule is symmetrical in relation to the centre of the chain, for example, the oxalic acid series, paraffins, fatty acids, etc., but this alternation may be inverted in series not having this symmetry, namely, ketonic acids, alkyl chlorides, etc. This alternation may be completely masked by the mass of a characteristic group being so great as to cover the influence of the carbon chain. The existence of a minimum melting point for one of the members of a series other than the first is very general, and is in accord with Hinrich's hypothesis. This minimum may be situated anywhere from C_1 to C_{10}, according to the series, but in the majority of cases it is reached at the C_3 member. G. F. M.

Latent Heats of Vaporisation. ERIC KEIGHTLEY RIDEAL (*Proc. Camb. Phil. Soc.*, 1921, **20**, 291—298).—The latent heats of evaporation of metals are calculated from two formulæ, (1) $L=Nh(v_2-v_1)$, where N is Avogadro's constant, h is Planck's constant, v_2 the vibration frequency of the vapour and v_1 the vibration frequency of the solid or liquid. v_2 is supposed to correspond with a radiation far in the infra-red, since experiment shows that practically all vapour atoms are active, *i. e.* adhere to the solid when they strike it, and the activating energy is therefore small. v_1 should correspond with some line in the spectral series, each representing a different degree of activation. It is shown by calculation that fair agreement is found when a line fairly widely separated from the other lines is chosen; this is at, or near, the head of a series. The second formula supposes that the activation of a metal atom occurs in two stages, the activation of the positive nucleus and the activation of the electron. If the corresponding activation frequencies are v_3 and v_4, respectively, and the activation frequency of the atom, which corresponds with the radiation potential, is v_5, then, according to Haber: (2) $L=\frac{1}{2}Nh\{v_5-(v_3+v_4)\}$. The values of L calculated by the two formulæ agree fairly with the experimental numbers except in the cases of mercury, tin, and lead. The values of v_3 were calculated by Lindemann's formula; those of v_4 by Haber's formula $Mv_3^2=mv_4^2$, where M and m are

the atomic and electronic masses, respectively. Where experimental values of v_5 were not available, they were calculated from the relation $v_5=v_4/2\cdot3$. The theory is extended to non-conductors.
J. R. P.

Vapour Tension Tables for Measurement of Temperatures between +25° and −185°. ALFRED STOCK, FRITZ HENNING, and ERNST KUSS (*Ber.*, 1921, **54**, [*B*], 1119—1129).—The tension thermometer consists of a thin glass tube on the end of which a small bulb is blown in which the liquid condenses during measurement; the tube is connected by a glass spring to a bulb of about 50 c.c. capacity (which enlarges the capacity of the instrument and thereby diminishes the error due to the possible presence of traces of gaseous impurity); the bulb is connected with a glass manometer and also a side tube which permits the introduction of the filling material. The apparatus is drawn to scale in the original communication and various modifications are suggested. The apparatus for filling is also figured. The various substances used for filling are as follows: the individual range (within which the tension has been measured for each degree centigrade by comparison with the temperature scale of the hydrogen thermometer of the Physikalisch-technische Reichsanstalt) being indicated in brackets: carbon disulphide (+25 to −18°), sulphur dioxide (−10° to −57°), ammonia (−33° to −77°), carbon dioxide (−77° to −110°), hydrogen chloride (−85° to −111°), phosphine (−87° to −133°), ethylene (−103° to −150°), ethane (−150° to −182°), oxygen (−179° to −185°). The methods of preparation and purification of the substances are fully described.

By means of these tables of tensions, it is readily possible to measure any temperature between the atmospheric and −185° accurately to within 0·1°. The thermometers are easily made and have the great advantage that they are not susceptible to the presence of impurities in the air of the laboratory. They are particularly sensitive in the neighbourhood of the boiling point of the filling material and, in consequence of their small capacity for heat, rapidly acquire the temperature of their surroundings. The thermal after effects observed with liquid thermometers are absent. Their readings are perfectly trustworthy as long as air has not leaked into them; this can be readily tested by cooling them in liquid air when the tension sinks to zero except in those cases in which methane is used. It should, however, be noted that the instrument records the temperature of the coldest part. H. W.

Vapour Pressure Regularities. VI. W. HERZ (*Zeitsch. Elektrochem.*, 1921, **27**, 216—218. Compare this vol., ii, 302).—It has been shown by Rechenberg that, by applying Dühring's formula, it is possible to calculate from the vapour pressure curves of different substances the temperature at which the vapour pressure becomes zero (A., 1920, ii, 587). It might be expected that the temperature, in absolute degrees, corresponding with zero pressure, would be a constant fraction of the boiling temperature at atmospheric pressure. This fraction has been calculated for

the substances for which Rechenberg has given the zero vapour pressure point, and the values obtained approximate to a constant. Thus for substances with vapour pressure curves of the hexane type, some of the values found are: hexane, 0·40; benzene, 0·405; aniline, 0·450; phenol, 0·478; nitrobenzene, 0·436; ammonia, 0·466; carbon disulphide, 0·380; chlorine, 0·379; whilst for substances of the water type were found water, 0·496; glycerol, 0·534; ethyl alcohol, 0·515; butyric acid, 0·500. The constancy found, however, is not of the same order as that obtained for the ratio of the absolute boiling points at different temperatures for different substances, and the opinion is ventured that Dühring's vapour pressure rule is only a useful empirical guide, and that no theoretical importance attaches to the zero vapour pressure point as calculated from it. E. H. R.

Boiling Point Relationships. RICHARD LORENZ and W. HERZ (*Zeitsch. anorg. Chem.*, 1921, **115**, 100—104).—According to the Guldberg-Guye rule, the boiling point of a liquid in absolute degrees at atmospheric pressure is equal to two-thirds of the critical temperature in the same units. The ordinary pressure is, however, no definite fraction of the critical pressure, and calculations have now been made to see whether a definite relationship exists between the boiling points at definite fractions of the critical pressure and the critical temperature. The fractions of the critical pressure employed were $\frac{1}{33}$ and $\frac{1}{50}$, and it was found, in the case of a large number of organic liquids, that a better constant was obtained for T_s/T_c, where T_s is the boiling point and T_c the critical temperature, when T_s was taken at a definite fraction of the critical pressure, $\frac{1}{50}$ giving a better constant than $\frac{1}{33}$. Inorganic liquids, of which only three were dealt with—water, nitrogen, and hydrogen sulphide—all gave low values of the constant, compared with organic liquids. A good constant was also obtained when the boiling points were compared at $2\frac{1}{2}$ times the critical density. E. H. R.

The Relation between Boiling Point in the Vacuum of the Cathode Light and Critical Temperature. P. WALDEN (*Zeitsch. anorg. Chem.*, 1921, **115**, 312).—An acknowledgment that part of the author's conclusions published under this title (A., 1920, ii, 665) were anticipated by Hansen (A., 1910, ii, 827). E. H. R.

Comparative Study of Fractionating Still-heads. NEIL PRESTON MOORE (*J. Physical Chem.*, 1921, **25**, 273—303).—An historical discussion of the various forms of still-head in use, both with and without temperature control, is entered into. These instruments have been used in the fractionation of mixtures of chloroform 75% and carbon tetrachloride 25% and the efficiency has been determined. The influence of certain factors on the fractionation has been noted and from the results of the experiments the author has constructed a new form of still-head which is far more efficient than any other yet described. All analyses of carbon tetrachloride and chloroform mixture were made by a

refractometric method which is described in the paper. The new still-head is made entirely of brass; it consists of two strips of brass, a bed plate 36 in. long, 6 in. wide, and $\frac{1}{16}$ in. thick, and a cover plate of the same dimensions except that the thickness is $\frac{1}{32}$ in. These plates are rounded at the ends. The bed plate carries 120 slotted angle strips made of 26 gauge metal and $\frac{1}{4}$ in. apart. Each strip is 6 in. $\times \frac{3}{16}$ in. with $\frac{1}{8}$ in. "turn up." This "turn up" is provided with slots $\frac{3}{32}$ in. deep and $\frac{1}{32}$ in. wide, so that each strip constitutes a dam $\frac{1}{32}$ in. high completely across the bed plate. The slots serve as open sluices through which the overflow liquid can travel down the still-head. The number of slots increases from the top of the still-head to the bottom; the top seven strips having five slots, the second seven strips having ten slots, and the number of slots increasing by five for each successive seven strips until the bottom seven has each ninety slots. The bed plate and cover plate are joined together by a strip of $\frac{1}{8}$ in. square brass rod which runs continuously round the plates and thus completely closes it in. At the lower end a brass tube $\frac{5}{8}$ in. diam. is soldered and this receives the vapour from the distilling flask; at the upper end a tube 6 in. long and $\frac{1}{2}$ in. diameter serves as the delivery tube. The still-head is usually set at an angle of 45° to the vertical, but this may be varied. Working with this apparatus under normal conditions, it is found that the efficiency of fractionation is increased from 47·8%, the best obtainable with the cylindrical still-heads, to 82·7%. J. F. S.

Fractional Distillation with Contact Ring Still-heads. R. LESSING (*J. Soc. Chem. Ind.*, 1921, **40**, 115—119$_T$).—The still-head is prepared from glass tubes 2·5—4·0 cm. wide and 40—150 cm. long which are drawn out into as wide a constriction as practicable at the lower end; it is packed with cylindrical rings of approximately equal height and diameter ($\frac{1}{4}$ inch) having a gap in the circumference and a more or less diametrical partition connected on one side with the cylinder but out of touch on the opposite side. They are disposed indiscriminately in the column at the angles which they find when dropped promiscuously into the vessel. In order to obtain the best contact between the liquid and vapour phase and to keep all surfaces well irrigated, it is desirable to induce as much return-flow as is compatible with the drainage capacity of the column and the avoidance of excessive back-pressure; this is conveniently effected by lagging the still-head with asbestos, cotton-wool, or corrugated cardboard and providing a reflux condenser which allows the required portion of the vapour to pass uncondensed and to distil over whilst the bulk is condensed and returned, copiously wetting the still-head.

Comparative experiments with mixtures of benzene and toluene and with fusel oil show that the new still-head is considerably more efficient in separating power than any of the usual types. This is attributed to the large surface per unit of volume, which affords ample opportunity for condensation of the vapours and re-evaporation of the condensate and to the turbulence created by

the frequent deflection of the currents of vapour and condensate which can only flow in any one direction for a distance of a quarter of an inch or less. H. W.

Constitution and Heat of Combustion. OTTO H. BINDER (*Chem. Zeit.*, 1921, **45**, 477—478).—The author discusses the relation between the constitution of organic compounds and their heat of combustion, the latter affording useful information regarding the constitution. In the case of isomerides, where the bonds are so arranged that they have equal heat values, the results obtained by calorimetric measurements must be the same. W. P. S.

Heats of Combustion and Formation of Nitro-compounds. I. Benzene, Toluene, Phenol, and Methylaniline Series. W. E. GARNER and C. L. ABERNETHY (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 213—235).—The heats of combustion and formation of a large number of nitro-derivatives of benzene, toluene, phenol, and methylaniline have been determined. A number of heats of crystallisation and nitration of some of the substances have also been determined. The present results, together with the most trustworthy values of previous investigators, are examined with the object of calculating the heat change occasioned by the entry of a nitro-group in the series examined. It is shown that the heats of formation of the nitro-compounds are markedly influenced by the position of the nitro-groups, and there is no regular change in these values similar to that observed in the introduction of a CH_2-group into aliphatic compounds; no empirical equation can be devised showing the relationships between the heats of formation of all aromatic nitro-compounds. It is shown that certain regularities exist between the heats of formation and nitration of the four series examined. The heat of combustion in all the series decreases with increase in the number of nitro-groups, but the heat of formation tends to a maximum for the second or third member of the series, and then diminishes. An exception is seen in the benzene series, but here it is probable that the maximum is shifted to the fourth member of the series, and that the same general relationship would hold if the more highly nitrated benzenes could be obtained and examined. A regularity is observed in the heats of formation of the di- and tri-nitro-derivatives of toluene, and this is expressed by the formula $H=30\cdot8-1\cdot3(n\times 4m\epsilon)$, where n is the number of nitro-groups ortho to the methyl group and m the number of nitro-groups ortho to a nitro-group. The introduction of the methyl group into benzene to form toluene modifies only slightly the shape of the curves showing the heat of formation of the nitro-compounds, but the introduction of an hydroxyl- or methylamino-group has a marked effect. The curves for the phenol- and methylamino-group are very much alike, which indicates that energy changes involved in the nitration are similar in the two cases. The heat of nitration curves for these substances are straight lines. There is no simple additive relationship for the entry of nitro-groups into benzene and toluene. The differences between the benzene and toluene derivatives on the one hand and the phenol and methylaniline derivatives on the

other are connected with the relative ease of nitration. In the three first-named series the nearer the nitro-groups are to one another the greater is the strain in the molecule and the lower the heat of formation. The sensitiveness of nitro-compounds to impact and their comparative instability run in line with their heats of formation; thus 2 : 3 : 4-trinitrotoluene which has the lowest heat of formation is the most sensitive to impact. The stability of the unsymmetrical trinitrotoluenes and benzenes is less than that of the symmetrical forms.

The large heat of formation of the nitrophenols is a disadvantage from the point of view of their employment as explosives, although this is to some extent balanced by their comparatively high oxygen content. Thus although trinitrotoluene contains 29% less of the oxygen necessary for complete combustion than does picric acid, yet its heat of detonation is similar, 924 cal./gram compared with 914 cal./gram (water gaseous in both cases). This is to be expected from the lower heat of formation of trinitrotoluene (128 cal./gram) compared with that of picric acid (277 cal./gram). In this example, the introduction of the hydroxyl group into benzene to form phenol is accompanied by the absorption of more energy than that of the methyl group to form toluene, and this is reflected in the explosion phenomena. The present figures show that the fifth member of a series has a very low heat of formation. The effectiveness of tetryl as an explosive is very largely dependent on its being the fifth member of the methylaniline series, and thus possessing a low heat of formation. The entry of the fourth nitro-group into the side chain does not affect this uniformity. Of the isomeric trinitrotoluenes, 2 : 3 : 4-trinitroluene is shown to have the lowest heat of formation, that is, it contains the lowest internal energy, whilst 2 : 4 : 6-trinitrotoluene has the highest heat of formation. If on detonation these two substances gave the same products of decomposition, the former would have an advantage over the latter of 54 cal./gram. For the same reason, *as*-trinitrobenzene would be a more powerful explosive than the symmetrical compound.

J. F. S.

Temperature and Degree of Polymerisation. W. HERZ (*Zeitsch. anorg. Chem.*, 1921, **115**, 237—240).—It is shown that the assumption that the ratio of molecular volume to density at corresponding temperatures for non-associated and associated liquids is constant leads to incorrect results. For monohalogenated benzenes, the ratio d_s/d_c, where d_s is the density at the boiling point and d_c that at the critical temperature, is 2·69. On the above assumption, $M_c/M_s = 2{\cdot}69 d_c/d_s$ for any liquid, where M_c and M_s are the molecular weights of the liquid at the corresponding temperatures. The ratio M_c/M_s for a number of known associated liquids, calculated from the above equation, is found to be very nearly unity. The same result was obtained taking other corresponding temperatures (equal fractions of the critical temperature) for comparison. It is concluded that the theory of corresponding states cannot be applied in cases where change of molecular state may occur. E. H. R.

An Empirical Law of the Molecular Volumes of the Halogens and their Compounds for all States of Aggregation. WILHELM BILTZ (*Zeitsch. anorg. Chem.*, 1921 **115**, 241—252).—It was shown by Fajans and Grimm (this vol., ii, 168) that when the molecular volumes of the haloids of one alkali metal are plotted against those of the corresponding haloids of another alkali metal, a straight line is obtained. It has now been found that straight lines are obtained when, against the molecular volumes of potassium chloride, bromide, and iodide as abscissæ are plotted as ordinates the molecular volumes of a great variety of halogen compounds. Not only simple and complex metallic chlorides, bromides, and iodides, but also a large number of crystalline chloro-, bromo-, and iodo-benzene derivatives were found to follow the same rule with remarkable precision. Fluorine derivatives do not generally fall into line with the other halogen compounds, and divergences are found when the molecular weights of the compounds of the halogens exceed about 200. The rule applies also to the liquid halogens and their hydrogen acids when the molecular volumes at their boiling points are compared. Similar relationships could not be found between the molecular volumes of compounds of other "homologous" or isomorphous series, for example, the sulphates, selenates, and chromates. In the course of the work, fresh determinations were made of the densities of magnesium chloride (d_4^{25} 2·32), magnesium bromide (*d* 3·72), magnesium iodide (*d* 4·255), aluminium chloride (*d* 2·41), *p*-chloroaniline (*d* 1·36—1·38), *p*-bromoaniline (*d* 1·763), and *p*-iodoaniline (*d* 2·07—2·11). E. H. R.

Analysis of Molecular Volumes from the Point of View of the Lewis-Langmuir Theory of Molecular Structure. ROBERT N. PEASE (*J. Amer. Chem. Soc.*, 1921, **43**, 991—1004).—A theoretical paper in which an analysis of molecular volumes, as determined from the critical data, has been made from the point of view of the Lewis-Langmuir theory of molecular structure and particularly of Langmuir's theory of isosteres. Evidence is brought forward to show that isosteric molecules and nuclear atoms in hydrogen compounds have the same volume. The volume depends, therefore, on the number and arrangement of electrons surrounding the positive nucleus of the atoms rather than on the charges on the nucleus, that is, on the particular kinds of atoms concerned. Thus, it has been shown that the nuclear carbon, nitrogen, and oxygen atoms of methane, ammonia, and water respectively have the same volume. The carbon atoms in ethane, ethylene, and acetylene have volumes increasing with the degree of unsaturation. The same observation holds in comparing the carbon atoms in benzene and *cyclo*hexane. The volumes of atoms thus increase with the number of electron pairs shared. An explanation of this is presented. It is shown that elementary nitrogen and carbon monoxide probably have the normal or acetylenic structure, three pairs being shared, rather than the condensed structure suggested by Langmuir. A structure is suggested for nitric oxide and the volumes of the inactive gases are considered from the point of view of Langmuir. J. F. S.

Some Factors Governing the Sorptive Capacity of Charcoal. Sorption of Ammonia by Coco-nut Charcoal. JAMES BRIERLEY FIRTH (*Trans.*, 1921, **119**, 926—931).

Stoicheiometry of Adsorption. I. Adsorption of Kations of the Alkalis and Alkaline Earths. SVEN ODÉN and HUGO ANDERSSON (*J. Physical Chem.*, 1921, **25**, 311—331).—The adsorption of alkali nitrates by charcoal has been determined, and it is shown that the amount of kation and anion adsorbed is equivalent in all cases; the statements to the contrary which are found in the literature are to be explained by the presence of acid or alkali left in the adsorbent after purification. From the isothermals the order of adsorption is $Li < Na < K < Rb < NH_4 < Cs$. Hence it follows that in this series the amount of adsorption increases with the atomic weight of the kation. In the case of the nitrates of the alkaline earths, the order of adsorption is $Mg < Ca < Sr < Ba$, which follows the same rule as the alkali nitrates. The measurements were all made with a Zeiss interferometer which determines the change in concentration after adsorption. The method of using the instrument for this purpose is fully described in the paper. The authors attempt to express the adsorbed quantity as a function of the remaining concentration by means of the Freundlich formula $y = kc^{\beta}$; using concentrations between 0·1 and 0·8 mol. per litre; it is found that k decreases from $4{\cdot}4 \times 10^{-3}$ for cæsium to $1{\cdot}31 \times 10^{-3}$ for sodium, whilst β increases slightly with decreasing atomic weight of the kation; the same type of relationship is also found with the nitrates of the alkaline earths. J. F. S.

The Reversibility of the Reaction $CaCO_3 = CO_2 + CaO$. PIERRE JOLIBOIS and BOUVIER (*Compt. rend.*, 1921, **172**, 1182—1183).—Using the method previously described (*ibid.*, 809) for registering the dissociation pressure of a compound, the authors have studied the conditions for reversing the dissociation of calcium carbonate. Calcium carbonate in various forms was used, and after heating to effect the dissociation, it was found that in no case on cooling was the reversal of the reaction complete. When, however, a mixture of precipitated calcium carbonate with excess of calcium oxide was used, complete reversal could be attained on cooling. W. G.

Crystallising Power of Compounds of High Molecular Weight. R. O. HERZOG and K. BECKER (*Zeitsch. physiol. Chem.*, 1921, **112**, 231—235).—General considerations without experiments. G. B.

Anisotropic Liquids. J. STEPH. VAN DER LINGEN (*J. Franklin Inst.*, 1921, **191**, 651—677).—With the object of ascertaining whether the pseudoisotropic layers of Lehmann and Bose have a space lattice, as is contended by Vorländer, molten layers of *p*-azoxyanisole, *p*-azoxyphenetole, anisaldazine, and active amyl cyanobenzylideneaminocinnamate have been allowed to solidify in

a magnetic field of 5000 gauss and the solidified layers examined as to their X-ray figures by Laue's method. The results show clearly and definitely that the pseudoisotropic layers of Lehmann and Bose do not possess homogeneity of structure as this term is understood in crystallography, nor is there any evidence to show that such layers are microcrystalline. Consequently, it is concluded that the experiments show that such layers do not possess a space lattice; that is, Vorländer's contention, based on the optical phenomena of such layers, cannot be accepted. The uniform dispersion, which was observed in all cases, is due to the regularity of molecular structure of these anisotropic liquids, probably caused by similarly oriented ellipsoids only one of the axes of which is fixed in space.

J. F. S.

A Theory of Slow Hydrolysis of Salts. A. TIAN (*Compt. rend.*, 1921, **172**, 1179—1181).—On the basis of the presence of colloidal suspension in cases of slow hydrolysis of salts, the following theory is proposed. The colloidal material, at first in extremely fine particles, will give, spontaneously by union of these particles, larger and larger granules which, for a given weight, will have a smaller and smaller surface. The hydrolysis of the salt will be limited by two reactions, produced by the salt and the water at the expense of the acid and base liberated. The first, occurring only in the aqueous phase, will be a reaction taking place solely between the ions, and will be the reverse of hydrolysis. The second, which may be considered as a supplementary retrogression, will occur between the insoluble phase and the aqueous liquid by action of the other soluble element of the salt. It will also be a saturation of the acid by the base, but effected between two phases. The velocity of this action will be smaller as the surface of separation becomes more limited. It will diminish therefore as the colloidal solution evolves, and, the hydrolysis being less and less limited, the decomposition of the salt will progress. The hydrolysis will be slow because the evolution of the colloidal solution will itself be slow.

W. G.

A Cause of Dispersion of the Colloid in an Important Class of Hydrosols. A. TIAN (*Compt. rend.*, 1921, **172**, 1291—1293).—Solutions of salts, the base of which is only slightly soluble, constitute hydrosols consequent on hydrolysis. In such hydrosols there is a special cause of stability which permits, within wide limits, of the reversibility of their transformations. This special cause is due to the spontaneous dispersion of the colloidal metallic hydroxide, which itself results from a chemical action. In the immediate neighbourhood of the colloid the retrogression of the hydrolysis is much more marked than in the rest of the aqueous phase. The excess of salt thus reconstituted diffuses away from the generating layer and then undergoes normal hydrolysis, giving again the metallic hydroxide temporarily dissolved and thus the dispersion of the colloid progresses. This theory is applied to certain phenomena.

W. G.

The Stability and the Reversibility of the Transformations of the Hydrosols obtained by Hydrolysis of Salts. A. TIAN (*Compt. rend.*, 1921, **172**, 1402—1404. Compare preceding abstract).—It has been shown (*loc. cit.*) that, in the hydrosols resulting from the slow hydrolysis of salts of heavy metals in solution, the hydroxide in colloidal suspension is continually divided and dispersed by a chemical process, and it is to this cause that the marked stability and the reversibility of the transformation of these hydrosols are due. These colloidal solutions are stable in the presence of electrolytes which normally flocculate pure hydrosols. The colloidal particles are capable both of uniting and dividing as already shown, and hence these hydrosols exhibit reversible colloidal transformations. W. G.

A Colloid Theory of the Corrosion and Passivity of Iron, and of the Oxidation of Ferrous Salts. JOHN ALBERT NEWTON FRIEND (Trans., 1921, **119**, 932—949).

Chemical Reactions and Radii of Curvature. R. LUCE (*Compt. rend.*, 1921, **172**, 1287—1288. Compare Reboul and Luce, *ibid.*, 197).—Further experiments are quoted in support of the view that the chemical action of a liquid on a solid depends on the shape of the latter, being greatest at those points where the mean curvature is greatest. Thus the influence of curvature is the same in liquids and in gases. W. G.

Chemical Affinity. A. KOREVAAR (*J. Physical Chem.*, 1921, **25**, 304—310).—A theoretical paper in which the author points out that the term affinity is used in the literature and in text-books in two senses, thereby causing considerable confusion. On the one hand, it is used to designate the force acting between combining atoms, this is, the classical definition, and on the other, it is used to express the thermodynamic conception, created by van't Hoff, which defines it as the maximum external work done by the chemical reaction at constant temperature and volume. The author reviews the use made of the term in a number of standard text-books and recommends that the term affinity should be used only in its classical sense, whilst the maximum external work should always be referred to as such and never as affinity. J. F. S.

Determinations of the Number of Independent Constituents of a System of Substances. F. WALD (*Bull. Soc. chim.*, 1921, [iv], **29**, 266—271. Compare Dubreuil, A., 1920, ii, 742).—The mathematical expression worked out by Dubreuil is developed so as to deal with more complex systems. H. J. E.

The Phenomenon of Partition. NICOLAS DE KOLOSSOVSKY (*Bull. Soc. chim. Belg.*, 1914, **28**, 257—264).—A study of the partition of hydrogen peroxide between water and ethyl ether. As the total concentration, P, increases, the coefficient of partition, C, between these two solvents at 18° diminishes, its value being given by $C=14{\cdot}77-0{\cdot}397P+0{\cdot}00432P^2$. If m and n represent the degrees

of association of hydrogen peroxide in the water and ether respectively under these conditions, then it is calculated that the ratio $n/m = 1{\cdot}3$, a value which is very close to that previously found for acetic acid in the same solvents (A., 1911, ii, 591). W. G.

Equilibrium in the System: Ammonia–Ammonium Nitrate–Ammonium Thiocyanate. H. W. Foote and S. R. Brinkley (*J. Amer. Chem. Soc.*, 1921, **43**, 1018—1031).—The vapour pressures have been determined at 0°, 10°, and 20° for the two binary systems ammonia–ammonium nitrate and ammonia–ammonium thiocyanate and also for three mixtures in the ternary system ammonia–ammonium nitrate–ammonium thiocyanate. The range of vapour pressure investigated was that from the saturated solutions to those showing pressures of about 1600 mm. Neither double salts nor solid products with ammonia are formed at 0° or above; but the saturated solutions are in equilibrium with the simple salts. The solubility curves of ammonium nitrate and ammonium thiocyanate in the three-component system have been determined at 0°, 10°, and 20°, together with the univariant point at which these curves intersect. The results show that, at the temperatures investigated, curves of equal vapour pressure in the ternary system are very nearly straight lines which connect points of equal vapour pressure in the two binary systems. The vapour pressures of the solutions examined are far below those required by Raoult's law. At any temperature, the saturated solution, containing ammonium nitrate and ammonium thiocyanate in approximately the molecular ratio 1 : 3, shows the lowest vapour pressure, and this solution must therefore be most efficient for absorbing ammonia from gaseous mixtures. J. F. S.

Equilibrium in the System: Ammonia–Water–Ammonium Thiocyanate. H. W. Foote (*J. Amer. Chem. Soc.*, 1921, **43**, 1031—1038. Compare preceding abstract).—The vapour pressure of solutions of ammonia in water have been determined at 0°, 10°, and 20°, and those of water, ammonia, and ammonium thiocyanate have been determined at 10°, 20°, and 30°. The solubility of ammonium thiocyanate in water and aqueous solutions of ammonia (3·49%—22·70%) has been determined at 10°, 20°, and 30°. No additive or double compounds are formed between ammonium thiocyanate and either water or ammonia. The results show that at the temperatures investigated curves of equal vapour pressure in the ternary system are very nearly straight lines which connect points of equal vapour pressure in the two binary systems.

J. F. S.

The System: Copper–Cupric Oxide–Oxygen. H. S. Roberts and F. Hastings Smyth (*J. Amer. Chem. Soc.*, 1921, **43**, 1061—1079).—A continuation of work previously published (this vol., ii, 98). The present paper deals with the measurement of the dissociation pressures of the liquid mixture of the two oxides of copper throughout the range where this solution is in equilibrium with cuprous oxide; the composition of the liquid in equilibrium

with solid cupric oxide from the eutectic temperature to 1230° and with solid cuprous oxide from the eutectic temperature to the minimum melting point of cuprous oxide; the measurement, at 1120° and 1150°, of the dissociation pressures for different compositions of the liquid when no solid phase is present; and measurements of the dissociation pressures of cuprous oxide within the temperature range where a liquid rich in copper is a dissociation product. It is shown that solid solution between cupric oxide, cuprous oxide, and copper is either non-existent or negligible. In conjunction with the determinations of Heyn (A., 1904, ii, 406) and Slade and Farrow (A., 1912, ii, 1057), the *TX* (melting point) relations from pure copper up to the mixture 81% cupric oxide 19% copper have been established. The general course of the *PT* curves in the system has been deduced from a consideration of the *TX* diagram. Data are presented for the three dissociation-pressure curves in the system $Cu_2O-CuO-O_2$; the melting point of the Cu_2O-CuO eutectic is shown to be 1080·2° at 402·3 mm.; and the melting point of cuprous oxide is 1235° at 0·6 mm. The energy changes for the reaction $CuO(s) \rightleftharpoons \frac{1}{2}Cu_2O(s)+\frac{1}{4}O_2(g)$ and the heat of fusion of cuprous oxide have been calculated from the data.

J. F. S.

Application of the Law of Mass Action to the Results obtained in the Action of β-Galactosidase on Galactose in Solution in Propyl Alcohol. MARC BRIDEL (*Compt. rend.*, 1921, **172**, 1288—1291).—When the law of mass action is applied to the synthesis of propyl β-galactoside by the action of β-galactosidase on galactose in solution in aqueous propyl alcohol containing from 35—70% of the alcohol, it is seen that equilibrium is not reached even after several months.

W. G.

Velocity of Chemical Reactions. JOHN EGGERT (*Zeitsch. angew. Chem.*, 1921, **34**, 181—183).—A lecture dealing with the study of chemical kinetics from the experiments of Guldberg and Waage up to the present day.

J. F. S.

The Oxidation of Arsenious Acid by Nitric Acid in Presence of Mercuric Ions; the Change of a Negative Catalyst to a Positive. ALFONS KLEMENC and FRIEDRICH POLLAK (*Zeitsch. anorg. Chem.*, 1921, **115**, 131—140).—The influence of mercuric nitrate at different concentrations on the velocity of oxidation of arsenious acid by nitric acid has been studied, by titrating the unchanged arsenious acid with iodine solution at regular intervals during the progress of the reaction. Preliminary experiments showed that the effect of mercury ions was to tend to inhibit the reaction. For the quantitative experiments the greatest care was needed to avoid contamination with impurities to obtain concordant results. At a concentration of $7·7\times10^{-6}$ mols. per litre the effect of the mercuric ions was to inhibit the reaction completely. With diminishing concentration the inhibiting effect became less marked down to a concentration of $7·7\times10^{-8}$, and at $7·7\times10^{-9}$ mols. per litre there was a positive catalytic effect, which

became still more marked at $7 \cdot 7 \times 10^{-11}$ mols. per litre. The positive catalytic effect at extreme dilutions is shown by the fact that when a blank experiment was repeated in a vessel which had been previously used for an experiment in presence of mercuric ions, the flask having been cleaned with great care, the reaction was still accelerated by traces of mercuric salt remaining. The sensitiveness of the reaction to the catalyst is extraordinary, as previously the smallest recorded effective concentration for catalysis was 7×10^{-6} mols. per litre of colloidal platinum in the decomposition of hydrogen peroxide. The effect of mercury in reducing the activity of palladium hydrosol recorded by Paal (A., 1918, ii, 303) is probably due to the negative catalytic action of the mercury. Mercury either as metal or in the ionic condition probably exerts a negative catalytic effect in oxidation processes generally.

E. H. R.

Influence of Physical Conditions on the Velocity of Decomposition of certain Crystalline Solids. C. N. HINSHELWOOD and E. J. BOWEN (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 203—212. Compare A., 1920, ii, 743).—The conditions governing the rate of decomposition of crystalline substances have been examined. It is shown that the rate of decomposition of silver permanganate at 110° depends on the size of the particles. In the case of crystals of average size 0·25 mm. × 0·027 mm., the velocity is greatly accelerated as the reaction proceeds, owing to the disintegration of the crystals, whilst with finely powdered material consisting of particles of 0·005 mm. diameter the initial velocity is much greater but the subsequent acceleration is much less. The conditions ruling the propagation of the decomposition from the surface of a crystal to the interior have been studied in the case of the decomposition of ammonium dichromate and potassium permanganate by heat. It is shown that if the decomposition products do not form a coherent film round the crystal the reaction proceeds without hindrance and may be strongly accelerated owing to the disintegration of the crystals, but if a film is formed the reaction is greatly retarded. With increasing temperature, the retardation becomes less and less marked and is succeeded by the usual type of accelerated reaction. This retardation is observed in the case of ammonium dichromate, but not in the case of potassium permanganate, because here the products are not firmly held. In the case of solid solutions of potassium permanganate in potassium chlorate, the retardation is observed in the initial stages of the decomposition. The connexion between the velocity of decomposition of particles of different sizes is not the same as that between the linear magnitudes, but considerably less. This implies that the surface which is effective in determining the rate of reaction is considerably greater than the apparent surface as deduced from the linear size of the particles. What appear to be individual crystals are really aggregates which are sufficiently loosely held together to allow decomposition to take place between them. The rate of evolution of oxygen from isomorphous mixtures of potassium permanganate and potassium

chlorate, of a series of compositions, has been determined at temperatures of 148—230·2°, and values have been deduced for 200° in each case. The temperatures employed are not high enough to decompose the chlorate, so that the permanganate is responsible for the evolution of the oxygen. From the results, the authors calculate the heat of activation for the equimolecular mixture and find the value 618 cal./gram-mol. potassium permanganate at 200°, or 309 cal./gram-mol. of the equimolecular mixture. The results show that no distinction can be drawn between physical and chemical forces. The chemical forces between the atoms of solid substances are profoundly modified by physical conditions, such as proximity to the surface, and by the presence of neighbouring atoms in the space lattice. Moreover, the decrease in potential energy attending the process of solid mixture leads to increased chemical stability in a way which can be calculated approximately from the heat of mixture. J. F. S.

Hydrolysis of Dichloro- and Hexa-aquo-chromic Chlorides. ARTHUR B. LAMB and GORTON R. FONDA (*J. Amer. Chem. Soc.*, 1921, **43**, 1154—1178).—The uncertainty of the present values of the hydrolysis constants of the dichloro- and hexa-aquo-chromic chlorides has been pointed out. The hydrolysis constant of the dichloro-chloride has been measured by two methods. The first is a modification of the Walker method, and involves a comparison of the conductivities of solutions of the dichloro-salt containing different amounts of hydrochloric acid. The second is a method already applied by Bjerrum to this problem, and involves a study of the kinetics of the transformation of the dichloro-compound into the hexa-aquo-compound, and in particular of the variation of the velocity constant of this reaction with the concentration of the hydrogen ion in solutions to which acid has been added. Knowing this variation, it is possible to compute the hydrolysis constant from the observed values of the velocity constant in pure aqueous solution. The value obtained by the first method is $K_g = 1{\cdot}8 \times 10^{-6}$, by the second $K_g = 2{\cdot}0 \times 10^{-6}$, which give the mean value $K_g = 1{\cdot}9 \times 10^{-6}$. It has been pointed out that the addition of small amounts of dichloro-chromic chloride to a solution and the observation of its change in conductivity offers a convenient method for the determination of hydrogen-ion concentrations, particularly when they are small, and that the results are not affected by the presence of chloride ions at a concentration equal to that of the dichloro-chloride ($0{\cdot}008M$). The hydrolysis constant of the hexa-aquo-chloride at 25° has been measured over a wide range of concentrations by five methods. An average value of $K_b = 1{\cdot}58 \times 10^{-4}$ at 25° was obtained, with an average deviation of less than 5%. Incidentally, in applying the method depending on the rate of inversion of sucrose, it was necessary to determine the acceleration produced by $0{\cdot}0074M$ acid at 25°, a much lower concentration than had previously been worked with at this temperature. In applying the Walker method to the hexa-aquo-chloride, it was also necessary to determine the location of the equilibrium between the dichloro-

chloride and the hexa-aquo-chloride at a concentration of $0{\cdot}008M$, both in the presence and absence of hydrochloric acid. It was found that in the former case 1·5% and in the latter 0·25% of the dichloro-salt was present in the equilibrium mixture at 25°.

J. F. S.

The Catalytic Action of certain Metallic Salts in Reactions of Organic Compounds. ANTOINE KORCZYŃSKI (*Bull. Soc. chim.*, 1921, [iv], **29**, 283—290; Willgerodt, A., 1887, 806; Slator, Trans., 1903, **83**, 729; Gay, Ducelliez, and Raynaud, A., 1914, i, 946).—An attempt is made to find a relation between catalytic action and atomic weight. Preparations of *p*-nitrophenyl thiocyanate and brominations of benzene have been carried out with various metallic salts as catalysts, and the yield obtained is compared with the atomic weight of the metal the salt of which is used. It is claimed that a certain periodicity is observed. H. J. E.

Action of Hydrolytic Diastases. MARC H. VAN LAER (*Bull. Soc. chim. Belg.*, 1920, **29**, 214—227).—Diastatic catalysis is a form of catalysis by hydrogen ions and the reaction velocity depends solely on the ratio enzyme/substrate. Within certain limits, the velocity increases with concentration of hydrogen ions. W. P. S.

Dimensions of the Atom. L. ST. C. BROUGHALL (*Phil. Mag.*, 1921, [vi], **41**, 872—876).—When the atomic diameter is calculated from b of van der Waals's equation by the relation $\sigma=(3b/2\pi N)^{\frac{1}{3}}$, where $N=2{\cdot}75\times10^{19}$, it is found that the increase in passing from one inert gas to the succeeding one is constant: helium 2·30, argon 2·86, krypton 3·14, xenon 3·42 ($\times10^{-8}$ cm.). This regularity is not found when the diameters are calculated from the viscosities. The regularity found is in agreement with Langmuir's theory.

J. R. P.

The Arrangement of the Periodic System of the Elements. GEORG SCHALTENBRAND (*Zeitsch. anorg. Chem.*, 1921, **115**, 127—130).—An attempt to explain the derivation of the periods of elements by an "extension" of the first hydrogen–helium period. In the derived period, in place of a hypothetical homologue of an element of the first period, a number of new elements appear which share the properties of the hypothetical element. E. H. R.

Natural Systems for the Classification of Isotopes, and the Atomic Weights of Pure Atomic Species as related to Nuclear Stability. WILLIAM D. HARKINS (*J. Amer. Chem. Soc.*, 1921, **43**, 1038—1060. Compare A., 1920, ii, 479, 745).—In an earlier paper (*loc. cit.*) the different atomic species were classified in series according to the composition of the nuclei of their atoms. The series are (1) thorium, (2) uranium, (3) lithium, and (4) metachlorine (Cl 17^{37}_{3}). The present paper adds two natural and experimentally determined methods of classification, which are complementary, (1) according to the isotopic number, and (2) according to the class number as defined further on. It is found that five variables, P, the atomic weight, or total number of protons

in the nucleus; N, equal to $P-M$, the number of negative nuclear electrons; M, the atomic number, or the net positive charge on the nucleus; N/P, which may be considered as the relative negativeness to positiveness of the nucleus; and n, the isotopic number, determine the composition of the atomic nuclei. These five variables would give ten two-dimensional curves, but the representation is greatly simplified by the fact that by a proper choice of the two independent variables (n and M) constant values of all five may be represented as straight lines. The isotopic number represents the number of neutrons of the formula pe necessary to represent the excess in the composition of the nucleus over what may be considered as the normal composition represented by the isotopic number, 0, which may be given as $(p_2e)_M$. The isotopic number is exactly twice the value of the function f in the Harkins-Wilson equation for atomic weights or $W=2(M+f)=2M+n$. The atomic species were classified according to their f values in an earlier paper (*loc. cit.*). The isotopic number 0 seems to represent the lowest isotope which is stable both with respect to disintegration and to aggregation, and includes about 70—80% of all known material. However, all isotopes with the isotopic number are not supposed to be stable. The isotopic numbers higher than 0 are represented by 54 hyperbolas when N/P and P are the independent variables, and by 54 straight horizontal lines when n is plotted on the Y axis. It is shown that the composition of any atom is $(p_2e)_M(pe)_ne_M$. The relative abundance of the atomic species of the different isotopic numbers on the earth and in meteorites is, $n=0$, earth 84·5%, meteorites 79·0%; $n=1$, earth 13·0%, meteorites 5·3%; $n=2$, earth 0·2%, meteorites 1·6%; $n=3$, earth 0·007%, meteorites 0·0; $n=4$, earth 2·2%, meteorites 12·4%; $n=5$, earth 0·046%, meteorites 0·1%. Thus the abundance is very high for the isotopic number 0, decreases to a minimum in isotopic number 3, rises to a secondary maximum in 4, and again decreases to 5 and 6. The difference of 4 isotopic numbers between the maxima corresponds with 4 neutrons or a helio-group, which is an α-particle plus two electrons, so that it indicates that in this range, as well as in the radioactive region, the α-particle is an important unit in atom building. In an α-disintegration the isotopic number remains constant; in β-disintegrations, it is lowered by two. β-Disintegrations of atoms of odd atomic number are in general much more violent than those of even atomic number. Nuclei may be classified into the four following classes which bear an important relation to nuclear stability: (1) both N and P even, comprising about 90% of known material, (2) N even and P odd, 5%; (3) both N and P odd, 2·5%, and (4) N odd, P even, 0·0%, where all percentages are atomic. Therefore $P-N$, or the atomic number is even for most atoms, and the atomic weights of elements of odd atomic number are almost always odd, whilst those of even atomic number are usually even. The number of isotopes of elements of even atomic number should be, according to the earlier theory of the author, considerably larger than the number of isotopes of elements of odd atomic number. On the basis of the relations in this and what has been said above,

the existence of a number of undiscovered isotopes is predicted. The general theory indicates that the number of isotopes per atomic number reaches a maximum somewhere in the region between atomic numbers 28 and 83, and that there are fewer isotopes in the radioactive region, and very many less in the region of few isotopes between atomic numbers 1 and 27. A system of nomenclature of the radioactive atomic species is put forward. The atomic weights of isotopes of odd atomic number are almost always odd numbers, in order to make the number of negative nuclear electrons an even number. However, the values of the N/P ratio for lithium of atomic weight 7 and boron of atomic weight 11 are so high that the presence of lower rather than higher isotopes is indicated by the theory; thus indicating that lithium has an isotope of atomic weight 6, and that boron has an isotope of atomic weight 10. Whilst these isotopes have been discovered, the author's prediction of their existence was made in an earlier paper before their discovery. The existence of isotopes of these elements with still lower atomic weights than these would be contrary to the general rule that N/P is never less than $\frac{1}{2}$ for stable complex atoms. The isotopes of even atomic number should have atomic weights which are mostly even numbers, although some odd atomic weights may occur. Thus most isotopes differ in atomic weight by 2. It is suggested that groups, such as the p_2e group, which contain one negative electron may be extremely stable with respect to disintegration, but that they tend to combine with each other and with other similar groups, or even with negative electrons alone, to form more complex groups in which the number of negative electrons is even. Thus two p_2e groups would combine to form an α-particle, or one p_2e group would unite with a negative electron to form a p_2e_2 group or double neutron. Thus such groups including Rutherford's p_3e, if it exists, would be stable with respect to disintegration, but not with respect to aggregation. In exceptional cases a p_2e group might attach itself to a larger atom nucleus, thus forming the isotope of lithium of atomic weight 6 by combining with one α-particle; that of nitrogen by combining with 3 α-particles and that of boron by a union with 2 α-particles. There are many facts which suggest that the disintegration of an atom need not be the exact reversal of its method of formation. J. F. S.

A Rotary Burner. GEORG LOCKEMANN (*Zeitsch. angew. Chem.*, 1921, **34**, 198).—A rotary burner for mechanically keeping in continual motion a Bunsen flame for use in such laboratory operations as ashing organic substances, distilling liquids, etc., consists of a horizontally rotating wheel driven by a motor or water turbine, on which is mounted vertically the burner tube in such a manner that the distance radially from the axis of rotation can be adjusted at will. The vertical tube is connected with a horizontal gas lead through an enlarged T-piece, forming a gas-tight socket in which it is capable of rotating. To avoid possible gas leaks at this joint, the gas is allowed to mix with air in the horizontal lead in the usual Bunsen burner fashion, so that should the socket become worn at

all, the suction of the flame will cause an inward flow of air instead of a gas leakage outwards. The whole apparatus is mounted on an ordinary iron laboratory stand, and several may be coupled in series by driving cords if desired, and all worked from the same motor. G. F. M.

Lecture Experiment: Reduction of Oleic Acid to Stearic Acid. R. FEULGEN (*Zeitsch. physiol. Chem.*, 1921, **114**, 1—3).—One gram of oleic acid in 10 grams of glacial acetic acid is quantitatively reduced in five minutes, by shaking with 0·1 gram of platinum black in an atmosphere of hydrogen. C. R. H.

Inorganic Chemistry.

Determination of the Atomic Weight of Tellurium. P. BRUYLANTS and G. DESMET (*Bull. Soc. chim. Belg.*, 1914, **28**, 264—266).—The starting material was pure tellurium prepared from hydrogen telluride. The tellurium was dissolved in nitric acid and the solution evaporated to dryness, the residue being calcined and melted. The tellurium dioxide was dissolved in pure aqueous sodium hydroxide and the tellurium estimated volumetrically either in alkaline or just acid solution by the method of Marckwald and Foïzik (A., 1910, ii, 604). The mean of twelve estimations in alkaline solution gave the value 127·8 for the atomic weight, and of nine estimations in acid solution the value 127·65. W. G.

Method of Producing Dry Ammonia. H. W. FOOTE and S. R. BRINKLEY (*J. Amer. Chem. Soc.*, 1921, **43**, 1178—1179).—A convenient method of storing and delivering dry ammonia is described. The apparatus consists of a 500 c.c. wide-necked bottle fitted with a stopper carrying two tubes with taps, one for delivery and the other for charging. The bottle is nearly filled with dry ammonium thiocyanate, which acts as adsorbent. The bottle is surrounded by ice and the charging tube connected to an ammonia generator, the ammonia as it enters the bottle is absorbed about as rapidly as by water, and when the ammonium thiocyanate is saturated, it contains about 45% of its weight of ammonia. The ammonia can be drawn off by slightly raising the temperature, room temperature is generally sufficiently high. This method has the advantages that the rate of evolution of the gas can be readily controlled by slight changes of temperature and also the gas evolved is absolutely dry. J. F. S.

Compounds of Ammonia and Carbonic Acid in Equilibrium with their Aqueous Solutions. ERNST TERRES and HANS WEISER (*Zeitsch. Elektrochem.*, 1921, **27**, 177—193).—The conditions under which the different compounds of ammonia and

carbonic acid are stable in contact with aqueous solutions of the components have been studied at temperatures from 0·1° to 60°. Only ammonium hydrogen carbonate forms a congruent solution in water, that is, one in which the ratio of CO_2 to NH_3 is the same both in solution and in the solid phase. Of the other compounds of ammonia and carbonic acid, precise conditions were known only for the formation of ammonium carbamate, but in the course of the work methods were found for obtaining both the salt, $2NH_4{\cdot}HCO_3,(NH_4)_2CO_3,H_2O$, and normal ammonium carbonate in a pure state. The former salt crystallises from solutions containing ammonia and carbon dioxide in the ratio 4 : 5. Normal ammonium carbonate was prepared by dissolving 395 grams of ammonium hydrogen carbonate in 150 grams of water and 333 grams of 25% ammonia solution, whilst passing in ammonia under an increased pressure of 0·2 atm. and warming at 40° until solution was complete. On cooling to 10°, the normal carbonate crystallised.

For the equilibrium experiments, solutions were prepared starting with each of the above four substances as solid phases, by dissolving them in different concentrations of ammonia. Owing to the slowness with which equilibrium was attained in those cases where a change of solid phase occurred, it was necessary to prepare the solutions at a higher temperature in order to obtain complete solution and then allow the solid phase to separate on cooling to the required temperature. The concentrations of ammonia and of carbonic acid were determined in the solution when equilibrium was reached, and the solid phase was examined both by analysis and microscopically. It was found possible readily to identify by their crystalline form the five solid phases which were found to occur, namely, ammonium hydrogen carbonate, normal carbonate, hydrogen carbonate–carbonate double salt, carbamate and hydrogen carbonate–carbamate double salt, $NH_4{\cdot}CO_2{\cdot}NH_2,NH_4{\cdot}HCO_3$.

Equilibrium diagrams for each temperature were constructed by plotting carbon dioxide % against ammonia % in the solution; changes of direction of the curve indicated a change of solid phase. By combining the diagrams for different temperatures, a three-dimensional diagram was constructed in which the fields corresponding with the different solid phases were indicated. The normal carbonate and the two double salts have a limited temperature range of stability. Starting from ammonium hydrogen carbonate, between 0° and 33°, with increasing ammonia concentration, the solid phases change consecutively to the hydrogen carbonate–carbonate double salt, normal carbonate, and finally carbamate. At about 33°, both the double salt and normal carbonate disappear, but the new double salt hydrogen carbonate–carbamate appears between the hydrogen carbonate and carbamate. No further change appears up to 60°, the temperature limit of the experiments.

E. H. R.

Flocculation of Colloidal Arsenic Sulphide. Principle of a Method of Study. A. Boutaric and M. Vuillaume (*Compt. rend.*, 1921, **172**, 1293—1296).—The spectrophotometric method

previously used to study the formation of precipitates (*Ann. Physique*, 1918, [ix], **9**, 183) has been applied to a study of the flocculation of colloidal arsenic sulphide. In order to have perfectly comparable flocculations, it is essential that the colloidal solution should not contain any free hydrogen sulphide or any free arsenious oxide. An excess of arsenious oxide has much less effect than an excess of hydrogen sulphide. The effect of free hydrogen sulphide varies with the nature of the electrolyte used as a flocculating agent. W. G.

Carbon Formed by the Action of Mercury on Carbon Tetrachloride, Tetrabromide, and Tetraiodide. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1921, **115**, 145—158).—By the action of mercury vapour on carbon tetrachloride at 600—700°, mercurous chloride is formed and carbon is deposited. Under high pressure, 900 to 2700 kilos per sq. cm., the reaction starts at about 400° and is accompanied by a fall in pressure. Carbon tetrabromide and tetraiodide react similarly. The carbon so formed retains water tenaciously, 7—10% after heating at 600° in a stream of nitrogen. The density of the carbon so obtained is high, 2·32 from carbon tetrachloride, 2·51 from the tetrabromide, and 2·37 from the tetraiodide, whilst that of graphite is 2·1—2·3. Carbon obtained similarly from hexachloroethane had d=2·16, from hexachlorobenzene 2·46 to 2·22, and from carbon disulphide 2·38. It appears that carbon formed by reactions not involving the formation of water has a higher density than that which is formed with water. On keeping, this dense form of carbon absorbs much water, and, when it is again dried, its density is found to have diminished. When carbon from carbon tetrachloride is heated for a short time at 2100—2300°, its density falls from 2·32 to 1·37. Chemically, the new, dense form of carbon is more reactive than sugar carbon (compare this vol., ii. 451). X-Ray examination failed to reveal crystalline structure, whilst sugar carbon appears to be to some extent crystalline. The high density of the new form of carbon is probably due to very close packing of extremely small particles. Heating to a high temperature causes the particles to increase in size with the result that the density decreases, without the appearance necessarily of a crystalline structure.

The condition diagram of carbon is discussed. The melting-point curve of graphite probably falls with increasing pressure, cutting the diamond curve near 1500°. The density of liquid carbon would then be greater than that of graphite. It is suggested that above the diamond field at high temperatures and pressures an unknown form of carbon exists, the density of which lies between that of graphite and diamond. Such a condition diagram accounts for the known properties of diamond and graphite and for the geological facts. E. H. R.

Oxidation of Carbon Monoxide by Passage with Oxygen or Air through the Silent Discharge and over Catalysts which decompose Ozone. ARTHUR B. RAY and F. O. ANDEREGG (*J. Amer. Chem. Soc.*, 1921, **43**, 967—978).—With the object of

finding a method for destroying carbon monoxide in air, the effect of passing this gas mixed with air or oxygen through an ozoniser and also over substances which catalyse the decomposition of ozone was studied. It is shown that the yield of ozone in the effluent gas by passing air or oxygen through a silent discharge is decreased by the presence of water vapour, by using a silvered electrode, and by having small arcs in series. There is an optimum rate of passage of the gas through the discharge, which in the present experiments is 7·72 litres per minute. This rate also gives the optimum formation of nitric acid. No appreciable oxidation of low concentrations of carbon monoxide in air or oxygen is effected by a low concentration of ozone unless the ozone is decomposed by special catalysts. Carbon monoxide may be almost completely oxidised by passage with pure oxygen or air through the silent discharge. The optimum conditions for obtaining maximum yields of ozone in the effluent gas are not necessarily the conditions for obtaining maximum oxidation. Other conditions being constant, the slower the rate of passage through the ozoniser the greater the amount of oxidation. The fact that under certain conditions more carbon monoxide is destroyed than can be oxidised by the maximum yield of ozone in the effluent gas when oxygen or air is ozonised under similar conditions, is accounted for by assuming the formation and decomposition of sufficient ozone in the ozoniser tube, or by assuming the formation of an active modification of carbon monoxide, or of oxygen other than ozone. The experimental evidence is insufficient to decide this point. By passing a mixture of air or oxygen containing relatively small amounts of carbon monoxide and ozone over a catalyst, such as silver, the carbon monoxide is readily oxidised, presumably as a result of the catalytic decomposition of ozone. Lead and lead dioxide are less effective catalysts, and manganese dioxide, unless specially prepared, is ineffective as a catalyst for the oxidation reaction, although it completely decomposes ozone. The carbon monoxide is most efficiently oxidised as regards time and energy when it is passed with air or oxygen through the silent discharge and over the silver catalyst. The best results are obtained when the undried air mixture is passed through a very large discharge unit and over silvered asbestos. The total oxidation obtained is apparently greater than can be accounted for by the assumption that it is all caused as a result of simple ozone decomposition—one molecule of ozone oxidising one molecule of carbon monoxide. The formation of an active modification of carbon monoxide or of oxygen other than ozone under these conditions is possibly indicated. The presence of hydrogen does not affect the oxidation of carbon monoxide in these circumstances. J. F. S.

The Behaviour of Carbon towards Silicon. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1921, **115**, 141—144).—The reaction between silicon and different forms of carbon when a loose mixture of equal weights of the two is heated has been studied. The temperature at which the reaction starts varies with different forms of carbon.

With carbon prepared by the action of mercury on carbon tetrachloride at 450°, the reaction started at 1220°, with soot from turpentine at 1340°, with sugar charcoal at 1410°, and with graphite at 1390°. The reaction product from the carbon from carbon tetrachloride, after freeing from uncombined carbon, appeared from analysis to contain the compound SiC. It consisted principally of microscopic particles with a small quantity of very thin needles. The density of the particles varied between 2·4 and 2·8. After ignition, the density of the heavier particles increased to 3·0, whilst the density of carborundum is 3·12. By using a higher proportion of carbon in the mixture, and also by heating carbon with silica at 1600° in a carbon tube, similar products were obtained containing, however, a higher proportion of carbon than SiC, but less than SiC_2. Further investigation is needed to determine the nature of the crystalline phases present in these products.

E. H. R.

The Binary Systems of Lithium Orthosilicate with Zirconium Orthosilicate and Calcium Orthosilicate. ROBERT SCHWARZ [with A. HAACKE] (*Zeitsch. anorg. Chem.*, 1921, **115**, 87—99).—The melting point of pure lithium orthosilicate, 1249°, is lowered by the addition of zirconium orthosilicate in proportion to the concentration of the latter, up to 30 mol.% $ZrSiO_4$, at which composition a pure eutectic is formed, m. p. 1021°. As the proportion of zirconium orthosilicate is still further increased, the melting point again rises to a maximum at 1152°, the melting point of the compound $3ZrSiO_4,2Li_4SiO_4$. Further increasing the proportion of zirconium orthosilicate, the melting point falls as far as 70 mol.% $ZrSiO_4$, to rise again subsequently, but experiments could not be continued beyond this point, as the mixtures could not be fused in the furnace used. The two silicates do not form mixed crystals. The mixtures containing 50 mol.% or more of lithium orthosilicate are readily attacked by cold water, the others by boiling water. Those containing a high proportion of zirconium orthosilicate resemble extremely hard porcelain. The densities of the mixtures were determined. The density increases from 2·28 (Li_4SiO_4) to a maximum 4·024 for the binary compound, falls slightly, and again rises to 4·51 ($ZrSiO_4$). The molecular weight of zirconium silicate, calculated by the Raoult–van't Hoff formula from the depression of the freezing point of lithium silicate, corresponds with the simple molecule $ZrSiO_4$.

The system: lithium orthosilicate–calcium orthosilicate is more complicated than the above. From 0—20 mol.% Ca_2SiO_4, pure mixed crystals separate; from the latter point up to 30 mol.% Ca_2SiO_4, mixed crystals separate until the composition reaches 30% Ca_2SiO_4, corresponding with a pure eutectic, m. p. 1092°. Throughout the remainder of the series mixed crystals are formed with melting point maxima at 40 and 60 mol.% and minima at 50 and 70 mol.% Ca_2SiO_4. A polymorphous change is indicated by an arrest point which has its greatest duration at 932° with 50 mol. % Ca_2SiO_4. Density determinations and microscopic

evidence confirm the existence of a compound Li_4SiO_4,Ca_2SiO_4 stable only below this temperature. Other thermal changes occur within 20° of this temperature in mixtures containing 35—45 and 55—65 mol.% Ca_2SiO_4 respectively, but their nature remains unexplained. The density of the compounds Li_4SiO_4,Ca_2SiO_4 is 2·847. Thin sections of this composition show fairly large doubly refracting granules, optically positive, probably biaxial, showing extinctions parallel to the cleavage. E. H. R.

Metallic Hydrides and the Action of Hydrogen on the Metals. I. E. TOMKINSON (*Chem. News*, 1921, **122**, 241—243).—A summary of the literature dealing with calcium, barium, and strontium hydrides. J. R. P.

Formation of Compounds and Solubility in Systems of the Type: Sulphuric Acid–Metal Sulphate. JAMES KENDALL and ARTHUR W. DAVIDSON (*J. Amer. Chem. Soc.*, 1921, **43**, 979—990. Compare this vol., ii, 45).—A continuation of work previously described. The solubility of the anhydrous sulphates of calcium, barium, magnesium, zinc, iron (ous), iron (ic), mercury (ous), mercury (ic), silver, aluminium, nickel, lead, and copper in anhydrous sulphuric acid has been determined at temperatures from the eutectic point upwards. Freezing-point determinations have been made over a similar temperature range. The following compounds have been isolated: $BaSO_4,3H_2SO_4$; $CaSO_4,3H_2SO_4$; which exists in two crystalline modifications, $MgSO_4,3H_2SO_4$; Hg_2SO_4,H_2SO_4; $Ag_2SO_4,2H_2SO_4$ and Ag_2SO_4,H_2SO_4, which exists in two crystalline modifications with a transition point at 66°. Ferrous sulphate and zinc sulphate also form double compounds, but the exact composition has not been ascertained. In the other cases, no double compounds could be isolated. The molecular solubility in anhydrous sulphuric acid at 25° is found to be: $CaSO_4$, 5·16; $MgSO_4$, 0·18; $Al_2(SO_4)_3$, $<0·01$; $ZnSO_4$, 0·17; $FeSO_4$, 0·17; $Fe_2(SO_4)_3$, $<0·01$; $CuSO_4$, 0·08; Hg_2SO_4, 0·78; Ag_2SO_4, 9·11; and $HgSO_4$, 0·02. Nickel sulphate and lead sulphate have a very small solubility at this temperature. The compounds obtained in the present investigation are considerably less complex and less stable than those given by the sulphates of the alkali metals (*loc. cit.*). If the metals are arranged in order of the electromotive series, compound formation is seen to be dependent on the position of the metal with respect to hydrogen. Only those metals much above hydrogen (for example, lithium and potassium) and those much below (for example, silver) show extensive acid salt formation. As the zero point is approached from either side, the stability of the complexes decreases until finally no compounds can be isolated. Solubility relationships throughout the series are found to follow a similar course. The alkali sulphates and silver sulphate are extremely soluble in sulphuric acid, the sulphates of the metals less pronouncedly positive or negative are much less soluble; the sulphates of metals with electrode potentials near to the zero point are practically insoluble. J. F. S.

Revision of the Atomic Weight of Lanthanum. Analysis of Lanthanum Chloride. GREGORY PAUL BAXTER, MUNRO TANI, and HAROLD CANNING CHAPIN (*J. Amer. Chem. Soc.*, 1921, **43**, 1080—1085).—Two samples of lanthanum material were subjected to a prolonged series of crystallisations as double ammonium lanthanum nitrates. The material thus finally obtained was shown to be entirely free from the other rare earths by spectroscopic examination. The material was converted into the chloride through the oxalate and oxide. The crystals of chloride first obtained were recrystallised four times and dried by keeping in a vacuum desiccator over fused potassium hydroxide. When it could be dried no further by this method, it was heated at 85°, whereby most of the water of crystallisation was expelled; the temperature was then raised to 130° to expel the last molecule of water. When this was complete, the temperature was raised to 360° for some time and the preparation then rapidly melted at 1000°. The heating was all carried out in hydrogen chloride, and after the fused salt had solidified this was replaced by nitrogen and eventually by air. The pure material was then transferred directly to a weighing bottle. The analysis was carried out both volumetrically and gravimetrically by the method previously described for the determination of the atomic weight of praseodymium (A., 1915, ii, 263). From six determinations the ratio $LaCl_3 : 3Ag$ was found to be 0·757895, the extreme values being 0·757930 and 0·757841, from which the atomic weight is calculated to 138·914. Seven determinations of the ratio $LaCl_3 : 3AgCl$ lead to the value 0·570410, the extreme values being 0·570331 and 0·570543, which give the atomic weight as 138·912. This is lower than the accepted value, but since the presence of the usual companions of lanthanum, cerium, praseodymium, and neodynium would raise the apparent atomic weight, this value must be regarded as a maximum. In the calculations, the specific gravity of anhydrous lanthanum chloride is taken as 3·947. J. F. S.

The Influence of Cerium on the Properties of Aluminium and of some of the more important Light Metal Alloys. J. SCHULTE (*Metall u. Erz*, 1921, **18**, 236—240).—Addition of small quantities of cerium (under 1%) to aluminium and alloys of aluminium containing 3% Cu or 3·3% Mg increased the ductility without altering the other properties, but it was without effect on alloys containing 10% Cu or 4% Ni, or 25% Zn. The nitrogen content of pure aluminium was considerably reduced by addition of 0·2% Ce, but, contrary to previous statements, cerium does not remove silicon from aluminium. [Compare *J. Soc. Chem. Ind.*, 1921, July.] A. R. P.

The Calculation of the Positions of Eutectic Points and Solubility Limits in Systems containing Iron. KARL DAEVES (*Zeitsch. anorg. Chem.*, 1921, **115**, 290—292).—Tammann has shown that in mixed crystal series there are certain limiting compositions beyond which the mixed crystals are or are not attacked by chemical

agents, and that these limits are found where the atomic proportion of one constituent is $\frac{1}{8}$ or a multiple of this fraction (A., 1919, ii, 398). In binary systems containing iron, for example, iron with carbon, titanium, phosphorus, arsenic, or boron, it is now found that similar atomic or molecular fractions are of importance. For instance, in the iron–carbon system, pearlite, with 0·89% C, contains $\frac{1}{8}$ mol. of Fe_3C; the solubility limit for carbon, 1·75%, corresponds with $\frac{2}{8}$ mol. Fe_3C; and the eutectic point, 4·29% C, corresponds with $\frac{5}{8}$ mol. Fe_3C. These relations may throw light on the molecular structure of alloys. E. H. R.

The Velocity of Diffusion of Carbon in Iron. IRIS RUNGE (*Zeitsch. anorg. Chem.*, 1921, **115**, 293—311).—Experiments were made to determine the velocity of diffusion of carbon into iron by measuring the change of resistance of iron wire in a current of gaseous hydrocarbon at high temperatures. Illuminating gas diluted with hydrogen had little or no action; toluene diluted with nitrogen reacted slowly, more quickly when diluted with hydrogen, whilst a rapid action was shown by mixtures of benzene with nitrogen, light petroleum (b. p. 90—100°) with hydrogen, and hexane with nitrogen or hydrogen. The resistance–time curves were similar in character to the theoretical curve, assuming the diffusion of carbon to follow the diffusion law. At 900°, the diffusion coefficient of carbon in iron is about 2×10^{-7} cm.^{2}/sec. With an active gas, at 930°, 0·6 mg. of carbon passes through 1 sq. cm. of surface in the first three minutes. The resistance change due to 1% of carbon is 5·7% at 920°, 7% at 830°, and 40% at 18° of the resistance at the corresponding temperature. The velocity of cementation falls off rapidly with temperature and is inappreciable at 700°. When cementation takes place above 900°, γ-mixed crystals are formed, and the product is found to consist of cementite and pearlite. At 800°, the β-iron takes up carbon to form an equilibrium mixture of γ-mixed crystals containing about 0·3% of carbon and β-iron. Whether diffusion takes place in the gaseous form or as carbon cannot be affirmed, but the marked influence of hydrogen on the rate of diffusion points to the former. E. H. R.

The Nature of Subsidiary Valencies. XXV. Stability of Complex Kations with Varying Magnitude of Anions. FRITZ EPHRAIM and FRANZ MÜLLER (*Ber.*, 1921, **54**, [*B*], 973—978).—It has already been shown that very large anions render small kations eminently capable of additive reactions (A., 1920, ii, 378), but evidence of the regular increase of the stability of the kationic complex with increasing size of the anion has only been deduced in the case of the halogens. Similar experiments are now described with the group, SO_4, SeO_4, CrO_4, MoO_4, WO_4, the method consisting in allying the ion with the nickelhexammine complex and measuring the temperature at which the ammonia tension of the product thus formed is equal to the atmospheric pressure. The stability of the complex is found to be independent of the atomic volume of S, Se, Cr, Mo, and W, but to increase proportionally with the molecular volume of the corresponding trioxide.

If a mixture of freshly-precipitated nickel hydroxide and ammonium molybdate is saturated with ammonia, the *compound*, $[Ni(NH_3)_5H_2O]MoO_4$, is obtained in sapphire-blue, hexagonal crystals; it is transformed by ammonia at 120° into *hexammine-nickel molybdate*, the ammonia tension of which is equal to the atmospheric pressure at 116°. Under similar conditions, ammonium tungstate and nickel hydroxide give dark blue, hexagonal crystals of the *compound*, $NiWO_4,6NH_3,8H_2O$, which is transformed by a current of ammonia at 125° into the *tetrammine*; the latter is converted by ammonia at the ordinary temperature in the presence of a trace of moisture into the *hexammine*, $[Ni(NH_3)_6],WO_4$, which has an ammonia tension equal to the atmospheric pressure at about 120°. Hydrated nickel hexammine chromate, $NiCrO_4,6NH_3,4H_2O$, pale green, quadratic crystals, is most readily obtained by solution of basic nickel chromate in concentrated ammonia and precipitation with alcohol; its constitution, however, appears to require further investigation. A mixture of this compound and the *substance*, $NiCrO_4,5NH_3,H_2O$, is obtained by the action of ammonia on a paste of nickel hydroxide and potassium chromate. *Nickelhexammine selenate* is prepared similarly from nickel hydroxide and sodium selenate, an intermediate aquo-ammine being obtained which is dehydrated in a current of ammonia at 100° and subsequently saturated with the gas at the ordinary temperature; its dissociation temperature is 168°. H. W.

Titanium Peroxide. MAURICE BILLY (*Compt. rend.*, 1921, **172**, 1411—1412).—From estimations of the active oxygen it is shown that all the compounds previously considered as salts of the oxide, TiO_3, are really complexes of hydrogen peroxide and pertitanic salts corresponding with the peroxide, Ti_2O_5. A complex double *potassium* salt was prepared having the composition $K_2SO_4,TiOSO_4$, and when it was dissolved in ice-cold water and alcohol added, the clear liquid decanted from the precipitate was found to contain hydrogen peroxide. A hydrate of the peroxide, Ti_2O_5aq., was also obtained by precipitation with alcohol from a solution prepared by pouring equimolecular quantities of potassium sulphate and titanyl sulphate into an excess of hydrogen peroxide.

W. G.

Atomic Weight of Germanium. JOHN H. MÜLLER (*J. Amer. Chem. Soc.*, 1921, **43**, 1085—1095).—The processes of purification of the germanium salt used for the determination of the atomic weight of this element embodied a more thorough treatment for the elimination of the known impurities of germanium than previously adopted. The chlorine–hydrochloric acid distillation process, although adequate for the removal of silica and tin, can scarcely be accepted as a means of eliminating the last traces of arsenic from germanium compounds. Four redistillations of the chloride from hydrochloric acid solution in a stream of chlorine failed to remove the last trace of arsenic. The treatment of the nearly pure germanium oxide with sufficient water to dissolve nearly all of it, and the fractional crystallisation of the hydrated

oxide from this solution, served a twofold purpose: to remove the much more soluble arsenic oxide at one end and to eliminate any remaining traces of tin and silica in the less soluble fractions at the other end. The formation of potassium germanofluoride was not carried out until the absence of the isomorphous stannofluoride and silicofluoride was ensured by complete removal of tin and silica from the original oxide. The stability of potassium germanofluoride and its non-hygroscopic character together with its complete decomposition in hydrogen chloride indicates that it is the most suitable germanium compound for accurate analysis. The complete conversion of the germanofluoride by hydrogen chloride, the germanium chloride volatilising, potassium chloride only being left, was established in all analyses by negative tests for both germanium and fluorine. The mean of seven determinations of the ratio $K_2GeF_6 : 2KCl$ gave 72·418 for the atomic weight of germanium, the extreme values being 72·41 and 72·45.

J. F. S.

Double Catalysis of Vanadic Acid and Hydrogen Peroxide. V. Auger (*Compt. rend.*, 1921, **172**, 1355—1357).—Pervanadic acid resembles perchromic acid in that its catalytic decomposition of hydrogen peroxide, the pervanadic acid being itself reduced to a vanadyl salt, becomes more rapid and more complete in the presence of an acid. Vanadyl salts, however, unlike chromium salts, are immediately oxidised to pervanadic acid in the presence of hydrogen peroxide, so that in the course of time the whole of the hydrogen peroxide introduced into an acid solution of vanadic acid is completely destroyed and the reduction of the vanadic acid is more or less marked, according to the hydrogen-ion content of the solution.

W. G.

Alkali Pentachloro- and Pentabromo-ruthenates [Ruthenochlorides and Ruthenobromides]. A. Gutbier, F. Falco, and Th. Vogt (*Zeitsch. anorg. Chem.*, 1921, **115**, 225—236).—Experiments were made to determine the degree of hydration of these salts, about which observers have disagreed. The salts were prepared from $H_2[RuCl_5]$ and $H_2[RuBr_5]$ and the corresponding alkali chlorides and bromides. Potassium ruthenochloride always crystallises in the hydrated form K_2RuCl_5,H_2O. It does not form a hexachloro-salt with chlorine, unlike the organic halogen salts of ruthenium. When dehydrated by heat, it decomposes. The corresponding rubidium salt contains one molecular proportion of water, but the cæsium salt was always obtained in the anhydrous form except on one occasion, when the monohydrate was obtained. The salts are sparingly soluble in water, forming yellow solutions which darken gradually at ordinary temperatures, quickly at the boiling point. The hydrolytic change is accompanied by an increase in electrical conductivity (compare Howe, A., **1904**, ii, 665). Of the ruthenobromides, the potassium and cæsium salts crystallise in the anhydrous form, the rubidium salt with one molecular proportion of water.

E. H. R.

Mineralogical Chemistry.

Tetrahedrite, Triplite, Anthophyllite, etc. EARL V. SHANNON (*Proc. U.S. Nat. Mus.*, 1920, **58**, 437—453).—Crystallographic notes are given of anglesite, calcite, and datolite from various American localities. Crystals of tetrahedrite from the Hypotheek mine, Pine Creek district, Idaho, gave, after deducting 13·57% of quartz:

Sb.	As.	Fe.	Cu.	Zn.	Ag.	S.	Total.
26·81	trace	5·13	37·70	3·87	trace	26·49	100·00

Massive, brownish-red triplite, resembling garnet in appearance, occurring with dark-blue tourmaline in a lithia-rich pegmatite at Chatham, Connecticut, contains rather more iron and has higher refractive indices (α 1·665, β 1·673, γ 1·682) than triplite from Nevada (A., 1913, ii, 715); analysis gave:

P_2O_5.	MnO.	FeO.	CaO.	MgO.	F.	H_2O.	Insol.	Total (less O for F).
32·81	52·40	4·95	3·18	0·58	9·09	0·35	1·17	100·70

A brown, fibrous and bladed mineral from Chesterfield, Massachusetts, closely resembling cummingtonite in appearance, is proved to be the gedrite variety of anthophyllite (anal. I). Under the microscope it is colourless, except where stained with limonite; α 1·644, γ 1·660. The bucholzite variety of sillimanite (anal. II) is found as sheets of white to pale green, finely fibrous material in

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	CaO.	MgO.	H_2O.	Total.
I....	49·66	6·74	1·23	18·09	0·05	3·38	18·62	1·56	99·33
II....	38·10	59·48	1·05	—	—	—	—	1·32	99·95
III....	45·12	6·29	23·67	5·93	trace	trace	9·36	9·12	99·49

pegmatite at Russell, Massachusetts; D 3·172—3·180, H 5, α 1·629, γ 1·635. Stilpnomelane altering to chalcodite (A., 1920, ii, 499) forms veins in diabase at Lambertville, New Jersey, as a very light, porous aggregate of greenish-brown or golden-brown scales (anal. III). L. J. S.

Palmierite from Vesuvius. FERRUCCIO ZAMBONINI (*Compt. rend.*, 1921, **172**, 1419—1422).—The original analysis of palmierite (A., 1907, ii, 628) showed a deficiency of sulphur trioxide for a normal salt and the formula has been in doubt. New material formed on recent lava in the crater of Vesuvius has the form of hexagonal scales with $a : c = 1 : 3·761$; it is optically uniaxial and negative with ω 1·712(Na). Crystalline material was prepared artificially by heating for one hour at 1000° and slowly cooling a mixture of potassium, lead, and sodium sulphates (5 : 7·5 : 9). This has D 4·50, is optically uniaxial and negative with $\omega = 1·71$, and on analysis showed SO_3 33·62, PbO 47·48, K_2O 17·53, Na_2O 1·31 = 99·94, corresponding with the formula $(K,Na)_2Pb(SO_4)_2$. Although

palmierite is closely related crystallographically to aphthitalite and the two occur intimately associated, they do not appear to form mixed crystals. L. J. S.

Synthetic Silicate Minerals. J. KOENIGSBERGER and W. J. MÜLLER (*Jahrb. Min.*, 1921, *Beil.-Bd.* **44**, 402—459).—A repetition of results already published (A., 1918, ii, 402) with remarks as to their bearing on natural occurrences in the drusy cavities of igneous rocks. L. J. S.

Amesite, Corundophilite, and Chromium-bearing Chlorites. EARL V. SHANNON (*Proc. U.S. Nat. Mus.*, 1920, **58**, 371—379).—Amesite (A., 1920, ii, 261) and corundophilite occur with diaspore, etc., in the emery mine at Chester, Massachusetts. The dark green corundophilite crystals gave anal. I, corresponding with $6(Mg,Fe)O,2(Al,Fe)_2O_3,3SiO_2,5H_2O$; refr. indices α 1·600, β 1·603, γ 1·610. A lavender-coloured chlorite with uvarovite on chromite from Newcastle, Eldorado Co., California, gave II, corresponding with $10RO,2R_2O_3,5SiO_2,6H_2O$; α and β 1·582, γ 1·593. A dark purplish-red chlorite with chromite from Deer Park, Wyoming, gave III; $6RO,R_2O_3,4SiO_2,4H_2O$; α 1·587, β and γ 1·590. These two chromium-bearing chlorites are almost optically uniaxial and are near to kämmererite.

	SiO_2.	Al_2O_3.	Cr_2O_3.	Fe_2O_3.	FeO.	CaO.	MgO.	H_2O.	Total.
I....	23·20	24·42	—	3·48	13·40	1·04	22·76	12·00	100·30
II....	29·36	18·81	1·53	—	1·65	2·20	35·67	11·34	100·56
III....	32·12	9·50	7·88	—	1·98	1·24	35·36	10·25	100·37*

* Including chromite 2·04%.

L. J. S.

Minerals from the Tungsten Mine at Trumbull, Connecticut. EARL V. SHANNON (*Proc. U.S. Nat. Mus.*, 1920, **58**, 469—482).—Analyses and optical data are given of the following: I, Prochlorite, friable aggregates of greenish-black vermiform crystals; formula $2FeO,2MgO,Al_2O_3,2SiO_2,2H_2O$. II, Epidote, ash-grey prisms resembling zoisite but with the crystal-angles of epidote. III, Muscovite, var. margarodite, occurring as pearly, radiating scales as an alteration product of topaz. IV, Margarite, snow-white, pearly, and fibrous, occurring with margarodite and topaz; formula $CaO,2Al_2O_3,2SiO_2,H_2O$. V, Scapolite, brownish-white, columnar aggregates with fluorite. These minerals, except the first, all contain fluorine, and the last in unusual amount; the presence of a fluor-meionite is assumed in isomorphous mixture.

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	CaO.	MgO.	K_2O.	Na_2O.	F.	H_2O.	Total.
I.	23·69	21·26	—	26·52	0·43	3·32	17·60	—	—	—	7·63	100·45
II.	36·89	28·50	5·92	0·52	0·02	27·26	0·21	—	—	0·60	1·29	101·21
III.	46·88	36·42	1·98	0·82	trace	1·77	1·36	6·24	0·38	n.d.	4·03	99·88
IV.	33·72	50·27	0·66	trace	trace	10·48	0·47	1·64	0·74	0·14	1·90	100·02
V.	51·38	25·22	trace	—	trace	15·16	0·73	1·20	2·86	2·74	0·55	101·82*

* Including Cl 1·98.

L. J. S.

Orientite, a New Hydrous Silicate of Manganese and Calcium, from Cuba. D. F. HEWETT and EARL V. SHANNON (*Amer. J. Sci.*, 1921, [v], **1**, 491—506).—This occurs as minute, brown crystals lining drusy cavities and as granular aggregates in manganese ores (psilomelane, manganite, etc.) at several places in the province Oriente, Cuba. The crystals are orthorhombic, with $a:b:c=0·6720:1:0·7916$. D 3·05, H $4\frac{1}{2}$—5, α 1·758, β 1·776, γ 1·795. The mineral is readily soluble in hot hydrochloric acid with evolution of chlorine and separation of flocculent silica. Before the blowpipe it fuses to a black, blebby glass. The mean (anal. I; traces MgO,ZnO,Cl) of three analyses of material containing some black inclusions gives the ratios $4CaO,2Mn_2O_3,5SiO_2,4H_2O$, or as an orthosilicate $Ca_4Mn'''_4(SiO_4)_5,4H_2O$. Since, however, the water is expelled only near red heat the formula is written as $H_4Ca_4(MnOH)_4(SiO_4)_5$. The mineral shows some relations to the kentrolite group.

	SiO_2.	Al_2O_3.	Fe_2O_3.	MnO.	O.	CaO.	H_2O (<110°).	H_2O (>110°).	Total.
I....	32·48	1·08	1·56	29·92	3·27	22·47	0·03	7·93	98·74
II....	23·76	4·50		20·91	—	4·36	15·60	8·20	99·88

An associated brown, amorphous mineral, D 2·5, H $2\frac{1}{2}$, optically isotropic with n 1·55, gave anal. II (also Mn_2O_3 21·31; insoluble 1·24). This seems to be a mixture of orientite and neotocite. L. J. S.

Analytical Chemistry.

Simple Method of Gas Analysis for Physiological Purposes. WILHELM TRENDELENBURG (*Zeitsch. Biol.*, 1920, **72**, 141—162).—Description of a single piece of students' apparatus, permitting the estimation of oxygen in blood, carbon dioxide in alveolar air, etc., with moderate accuracy. G. B.

A Hydrogen Electrode Vessel adapted for Titrations. A. BAIRD HASTINGS (*J. Biol. Chem.*, 1921, **46**, 463—466).—The electrode vessel, which is designed to render possible the measurement of hydrogen-ion concentration and the making of electrometric titrations without allowing the escape of volatile matter, is made in two portions, an upper, stationary part, to which a paddle-shaped electrode is attached, and a lower, rotating part. The two portions are connected by means of a mercury seal. The rotating vessel is closed at the bottom by a stop-cock with a right-angled bore, by means of which the solution under investigation enters the chamber and the stem connecting it with the exterior is filled with potassium chloride solution. Electrical connexion with the calomel electrode is effected by leaving a central band of the stop-

cock ungreased. The vessel is first filled with hydrogen and the solution under investigation then placed in it. A continual stream of the gas is unnecessary. Hydrogen-ion determinations of standard solutions made simultaneously with the Clark electrode and this apparatus agreed within one millivolt. E. S.

Method for the Estimation of the Acidity of Coloured Solutions. J. L. LIZIUS (*Analyst*, 1921, **46**, 194—195).—A filter-paper in a small Buchner funnel is moistened with phenolphthalein solution and the excess of the latter is removed by suction. The liquid under examination is titrated with standard alkali solution, the approximate end-point being ascertained by transferring drops of the solution to the filter-paper. The whole solution is then filtered; if the paper retains a pink coloration, too much alkali solution has been added, and it is treated with a small volume of standard acid and again filtered, these operations being repeated until the colour of the filter paper is changed by the addition of 0·05 c.c. of acid or alkali solution. W. P. S.

Detection and Estimation of traces of Hydrogen Peroxide. F. W. HORST (*Chem. Zeit.*, 1921, **45**, 572).—Hydrogen peroxide is estimated by reducing it with ferrous sulphate solution and determining the ferric sulphate colorimetrically by ammonium thiocyanate. As the ferrous solution must be absolutely free from ferric salts, it is placed in a closed Erlenmeyer flask and a current of hydrogen sulphide is passed first through the cold and then through the boiling solution, which is subsequently cooled in a current of carbon dioxide. Twenty c.c. of the sample to be tested are placed in a graduated tube, and a few c.c. of light petroleum added to form a layer above the sample and prevent oxidation during the reaction. After the introduction of 2 c.c. of the ferrous sulphate solution, the mixture is agitated by a current of carbon dioxide which must be previously freed from oxygen by passing it through ferrous sulphate solution. Five c.c. of a concentrated solution of ammonium thiocyanate solution are then added, and after further agitation the colour is compared with that of a known standard solution.

W. J. W.

Estimation of Chlorine, Sulphur, and Phosphorus in Organic Substances. ACH. GRÉGOIRE and EM. CARPIAUX (*Bull. Soc. chim. Belg.*, 1919, **28**, 331—335).—The method described is for use with plant products, and is a slight elaboration of that of Villiers (A., 1897, ii, 522). The material is digested with concentrated nitric acid and a little potassium permanganate in a specially designed apparatus, which is figured and described in the original. The sulphur and phosphorus remain in the flask as sulphuric and phosphoric acids, whilst the chlorine distils off along with nitrous fumes and is collected in water as hydrochloric acid. These three acids are then estimated by the usual methods. W. G.

Gasometric Estimation of Hypochlorites. ALEXANDER KILLEN MACBETH (*Chem. News*, 1921, **122**, 268).—A gasometric method for estimating hypochlorites consists in treating them in a

van Slyke nitrometer with an alkaline solution of hydrazine, and measuring the nitrogen evolved. In absence of free chlorine trustworthy results are obtained. The available chlorine in bleaching powder may be estimated by this method. It has not proved suitable for estimating chlorates. W. J. W.

The Kjeldahl Method. H. W. DAUDT (*J. Assoc. Off. Agric. Chem.*, 1921, **4**, 366—373).—Investigation of this method and its modifications showed that the proportion of sulphuric acid to alkali sulphate is important; with 10 grams of potassium sulphate or 8·2 grams of sodium sulphate, 20—25 c.c. of sulphuric acid effect the most complete decomposition of a substance. The time of boiling, apart from the preliminary digestion, should be at least two hours, unless a shorter period is known to be effective for any particular substance. A quantity of copper sulphate not exceeding 0·5 gram does not cause retention of ammonia, but copper sulphate is not as effective as mercury. Sodium thiosulphate may be used in place of potassium sulphide for decomposing ammonium mercury compounds. W. P. S.

Estimation of Ammoniacal Nitrogen in Fertilisers containing Calcium Cyanamide and Ammonium Salts. J. FROIDEVAUX and H. VANDENBERGHE (*Ann. Chim. anal.*, 1921, **3**, 146—151).—A solution of the sample is treated with an excess of sodium hydroxide solution, and a current of air is drawn through the mixture and then passed through a known volume of standard acid; about seven hours are required to remove the ammonia from 0·25 gram of ammonium sulphate. The mixture is maintained at the ordinary temperature during the whole time and at the end of the operation the excess of the standard acid is titrated. W. P. S.

Colorimetric Estimation of Phosphoric Acid. ACH. GRÉGOIRE (*Bull. Soc. chim. Belg.*, 1920, **29**, 253—258).—Forty-five c.c. of a solution containing from 0·002 to 0·025 mg. of P_2O_5 and 2 c.c. of nitric acid (D 1·12) are treated with 2 c.c. of molybdic acid–quinine reagent, then diluted to 50 c.c., and the coloration obtained is compared with that of a standard mixture prepared under the same conditions. Small quantities of silica do not interfere, but iron should be removed previously by means of the "cupferron" reagent. The quinine reagent is prepared by dissolving 1 gram of quinine sulphate in dilute nitric acid, adding a quantity of barium hydroxide sufficient to precipitate the sulphuric acid, filtering the mixture, and adding the filtrate to a solution of 40 grams of ammonium molybdate in 500 c.c. of nitric acid (D 1·20); the whole mixture is then diluted to 1 litre. W. P. S.

A Gravimetric Method of Estimation of Small Amounts of Phosphoric Acid. GUSTAV EMBDEN (*Zeitsch. physiol. Chem.*, 1921, **113**, 138—145).—A micro-method for the estimation of phosphate is described, depending on precipitation as strychnine phosphomolybdate (A., 1909, ii, 266). The method is applicable with accuracy to quantities of P_2O_5 from 1 mg. upwards; since the

precipitation is carried out in neutral or faintly acid solution, the method is suitable for the estimation of inorganic phosphoric acid in the presence of easily hydrolysable organic phosphoric acid compounds such as lactacidogen (compare also A., 1900, ii, 757; 1901, ii, 343; 1915, ii, 66). C. R. H.

Volumetric Estimation of Alkali Pyrophosphates. FRANZ LUTZ (*Magyar Chemiai Folyóirat*, 1919, **25**, 96—98; from *Chem. Zentr.*, 1921, ii, 949—950).—In the estimation of pyrophosphates soluble in water, a known excess of $N/10$-silver nitrate is added. After making up to a certain volume, the precipitate of silver pyrophosphate is removed by filtration and the silver remaining in the filtrate titrated with ammonium thiocyanate solution, using iron alum as indicator. It was found that the greater the dilution after the precipitation of the silver pyrophosphate the better were the results obtained, owing to the dissociation of double salts formed in more concentrated solutions. As silver pyrophosphate is soluble even in a 1% solution of sodium pyrophosphate, the solution of the latter is added in small quantities to the excess of silver nitrate solution with constant shaking. Any acidity must be carefully neutralised by addition of $N/10$-sodium hydroxide after precipitation, since silver pyrophosphate is soluble in the weakest acids. G. W. R.

Iodometric Estimation of Arsenic Acid. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 727—728).—The author disagrees with Fleury's contention that in the estimation of arsenates by treatment in acid solution with potassium iodide and titration of the iodine with thiosulphate, erroneous results are obtained, due to the action of dissolved oxygen on the iodide (A., 1920, ii, 448). W. J. W.

A Simple Method for the Direct Estimation of Sodium in Small Amounts of Serum. BENJAMIN KRAMER and FREDERICK F. TISDALL (*J. Biol. Chem.*, 1921, **46**, 467—473).—In the estimation of sodium in blood as pyroantimonate (A., 1920, ii, 268), the sodium may be precipitated directly from the serum. E. S.

Sodium Salicylate as Reagent for the Microchemical Detection of Aluminium, Iron, Chromium, and Manganese. C. VAN ZIJP (*Pharm. Weekblad*, 1921, **58**, 694—698).—Sodium salicylate reacts with aluminium nitrate to form colourless needles which have a tendency to unite into spherical masses; excess of aluminium retards production of crystals, whilst in presence of excess of sodium salicylate the crystals dissolve. The reaction is improved by adding cæsium chloride, and is also rendered more definite by exposing the drop of the mixed solutions to the action of ammonia vapour, by which means formation of aluminium hydroxide is avoided. In solutions of aluminium salts, the presence of iron is indicated by the brown colour imparted to the crystals; there is no precipitation of hydroxide. On the other hand, whilst no hydroxide is at first formed with a mixture of aluminium and chromium salts, such precipitation occurs extensively as the drop

evaporates, together with production of colourless crystals. When both iron and chromium are present in the aluminium solution, brown crystals and a brown hydroxide precipitate are formed on evaporation. Manganese salts give no crystals with sodium salicylate, but when the mixed solutions are subjected to treatment with ammonia vapour, light-green needles are formed. With a suitable amount of sodium salicylate this reaction is very sensitive even in presence of zinc. W. J. W.

Comparison of the Analytical Methods used for Alloys: Estimation of Manganese in Cast-iron. F. GRAZIANI and L. LOSANA (*Giorn. Chim. Ind. Appl.*, 1921, **3**, 148—152).—For the estimation of manganese in cast-iron, gravimetric methods are the most accurate, but are too long for ordinary purposes; the latter are best served by Campredon's modification (*Guide prat. chim. métall. l'essayeur*, 1909, 511) of the Volhard method [compare *J. Soc. Chem. Ind.*, 1921, July]. T. H. P.

Reaction of Tin Salts. G. BRESSANIN (*Ann. Chim. anal.*, 1921, **3**, 155).—A reaction published recently by Mazuir (A., 1920, ii, 197) had been described previously by the author (A., 1912, ii, 994; 1914, ii, 146). W. P. S.

Separation of Silicon, Tin, Titanium, and Zirconium by means of Sodium Carbonate. PAUL WENGER and JULES MOREL (*Ann. Chim. anal.*, 1921, **3**, 139—142).—A weighed mixture of the four oxides is fused with six times its weight of sodium carbonate for three hours; the mass is then boiled with water and the solution filtered. The filtrate contains the silica and a portion of the tin; it is evaporated with the addition of nitric acid, the resulting residue of silica and metastannic acid collected and weighed, and the silica separated subsequently by treatment with hydrofluoric acid. The insoluble portion, containing the titanium and zirconium oxides and the remainder of the tin, is ignited, weighed, fused with eighteen times its weight of potassium hydrogen sulphate, the fused mass boiled with water acidified with nitric acid, and the mixture filtered. Metastannic acid remains insoluble, whilst the zirconium and titanium oxides dissolve and are separated by treating the neutralised filtrates first with hydrogen peroxide to precipitate the zirconium and then with an excess of ammonia to precipitate the titanium. W. P. S.

The Iodometric Estimation of Mercaptans. J. W. KIMBALL, R. L. KRAMER, and E. EMMET REID (*J. Amer. Chem. Soc.*, 1921, **43**, 1199—1200).—A modification of the method of Klason and Carlson (A., 1906, ii, 255) gave excellent results with all the mercaptans analysed, both aliphatic and aromatic. Thirty-five c.c. of $N/10$-iodine solution in aqueous potassium iodide is measured into a 250 c.c. stoppered bottle. About 0·25 gram of the mercaptan in a stoppered weighing tube is added, and the bottle stoppered and well shaken to mix the two substances. The excess of iodine is titrated with $N/10$-thiosulphate solution, using starch as an indicator. W. G.

A Method of Applying to Plants the Biochemical Process for the Detection of Dextrose. M. BRIDEL and R. ARNOLD (*Compt. rend.*, 1921, **172**, 1434—1436. Compare A., 1920, ii, 337).—The leaves or other plant material are extracted with boiling alcohol, the extract being diluted with water and defecated with lead acetate. The excess of lead is precipitated by hydrogen sulphide and the filtrate from this is evaporated to dryness under reduced pressure at a temperature not exceeding 50°. The residue is extracted first with ethyl acetate and then successively with fresh portions of 95% alcohol. The alcoholic extracts are united and evaporated under reduced pressure in the presence of calcium carbonate. The residue is extracted with 50% methyl alcohol. In one portion of the extract the reducing sugars are estimated. To the rest emulsin is added and the mixture kept at 20°, the reducing sugars being estimated from time to time. A diminution in the amount of these present is indicative of the presence of dextrose in the plant material. W. G.

The Inversion and Estimation of Sucrose. A. R. ROSE (*J. Biol. Chem.*, 1921, **46**, 529—535).—A more detailed account of work previously described (A., 1918, ii, 247). E. S.

Estimation of Carbohydrates in Vegetable Foods. VICTOR C. MYERS and HILDA M. CROLL (*J. Biol. Chem.*, 1921, **46**, 537—551).—Soluble carbohydrates in the edible portions of vegetables and fruits are estimated by the Lewis-Benedict method as used by Rose (A., 1918, ii, 247). For the estimation of the total available carbohydrate a weighed quantity of the ground vegetable is first boiled with water, then ground to a paste and the starch hydrolysed by "taka-diastase." An aliquot part of the filtered solution is acidified with concentrated hydrochloric acid until about $0{\cdot}6N$ and the hydrolysis completed by boiling. After nearly neutralising with strong sodium hydroxide solution the estimation is completed by the method used for the soluble carbohydrates. A separate determination of the reducing sugar contained in the "taka-diastase" is made and a correction applied. The results of numerous estimations of carbohydrate in vegetables and fruits are given. E. S.

The Estimation of Bases Combined with Weak or Moderately Strong Acids and of very Weak Bases with Acids and Vice Versa. I. M. KOLTHOFF (*Zeitsch. anorg. Chem.*, 1921, **115**, 168—180).—Although tropäolin-O and -OO are comparatively insensitive indicators to acids and alkalies, they are valuable for certain titrations for which more sensitive indicators are unsuitable, for example in the titration of an acetate of an alkali metal with an acid. In the titration of potassium acetate with hydrochloric acid, the change of hydrogen-ion concentration at the neutral point is rapid if normal solutions are used, but far more gradual with $0{\cdot}1N$- or $0{\cdot}01N$-solutions. Even with normal solutions, dimethyl-yellow gives an acid reaction when only 80% of the acetate is neutralised, but tropäolin-O gives a good end point, with an error of only 0·3%. Titrations should not be made with

solutions weaker than normal. A comparison solution consisting of a 0·5*N*-solution of acetic acid containing the same amount of indicator as the solution to be titrated is used to determine the end point. Salts of other weak acids having a dissociation constant smaller than $1—2 \times 10^{-4}$ can be titrated similarly. Weak bases such as aniline, having a dissociation constant greater than 10^{-10}, can also be titrated with tropäolin-O as indicator. Very weak acids such as phenol, and salts of moderately strong bases, such as ammonium salts, can be titrated with sodium hydroxide, using the same indicator and a suitable standard for determining the end point. E. H. R.

Simultaneous Detection of Tartaric Acid, Oxalic Acid, and Formic Acid by Resorcinol and Sulphuric Acid. F. KRAUSS and H. TAMPKE (*Chem. Zeit.*, 1921, **45**, 521).—About 0·2 gram of resorcinol is dissolved in 5 c.c. of a dilute sulphuric acid solution of the mixed acids and 10 c.c. of concentrated sulphuric acid are then added so as to form a layer below the solution. The evolution of carbon monoxide and the formation of an orange-coloured ring at the junction of the two liquids indicate the presence of the formic acid; below this orange ring is a blue ring, due to the presence of the oxalic acid, and, when the lower part of the mixture is heated, a deep-red coloured ring below the blue ring denotes the presence of the tartaric acid. The solution to be tested must not contain carbonates, sulphides, iodides, bromides, or oxidising substances. W. P. S.

Determination of the Composition of Mixtures of Eugenol and *iso*Eugenol Benzoates by means of Melting Points. PHYLLIS VIOLET MCKIE (Trans., 1921, **119**, 777—779).

Bromometric Estimation of Salicylic Acid. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 699—702).—The accuracy of the bromometric method for estimating salicylic acid has been investigated. For the estimation of small amounts of salicylic acid, such as weak solutions of approximately 0·008—0·012 mol. concentration, 25 c.c. are mixed with 25 c.c. of *N*/10-potassium bromate, 1 gram of sodium bromide, and not more than 5 c.c. of 4*N*-hydrochloric acid. After remaining for five to ten minutes in a stoppered flask, 5 c.c. of *N*-potassium iodide are rapidly added, and the mixture is titrated with *N*/10-thiosulphate; starch must be added only towards the end of the titration. The addition of alcohol, as in the bromometric estimation of phenol, may be omitted.
W. J. W.

Applications of Complex-Chemistry to the Problems of Organic Chemistry. I. A New Method for the Titration of Enols in Keto-enolic Mixtures. WALTER HIEBER (*Ber.*, 1921, **54**, [*B*], 902—912).—The method depends on the formation of complex copper salts which are freely soluble in chloroform and quantitatively retained by this solvent in the presence of water and on the quantitative retention of copper acetate by water in the presence of chloroform which may also contain alcohol.

The stock copper acetate solution is prepared by dissolving the crystalline salt (50 grams) in water (1000 c.c.). A suitable quantity of this solution (generally 6—10 c.c.) is mixed with alcohol (about 12 c.c.) and chloroform (6—8 c.c.) and cooled to about $-10°$, thus giving a supersaturated solution, from which, however, nothing separates for some hours. A weighed quantity of the substance under investigation is dissolved in a little cooled alcohol, chloroform being added if necessary. The former solution is rapidly added to the latter, and the clear, transparent mixture is shaken and immediately poured into a separating funnel containing about 250 c.c. of water. The whole process can easily be effected in from five to ten seconds. The lower chloroform layer containing the enolic copper salt is run into a second separator and the funnel is washed with a little of the same solvent. The copper salt is decomposed with dilute sulphuric acid and the chloroform is removed; potassium iodide (2—3 grams) is added and the copper estimated by titration with $N/10$-thiosulphate in the presence of starch.

It is shown that enols react instantaneously with copper acetate solution, and that, under the conditions adopted, the keto-enolic equilibrium is not sensibly displaced by the liberated acetic acid or by the excess of copper acetate. Since, however, the enolic copper salts are very sensitive towards acid, it is essential to use an excess of copper acetate in order to hinder their decomposition by the liberated acetic acid. With pure enolic substances, it is sufficient if double the calculated amount of acetate is taken. With mixtures, however, such a relatively large excess has an enolising effect on the ketone, and, in these cases, the necessary quantity is best determined by preliminary experiments with varying amounts of acetate. Under these conditions, the effect of temperature and duration of experiment is much less marked than with the bromine titration method.

The results obtained with the copper acetate method are in good agreement with those of the bromine titration method in the cases of acetoacetic ester and analogous substances. In the instances of the oxalyl ketones, on the other hand, the former process yields considerably lower results than the latter.

In cases such as those of acetoacetic ester, diacetyl- (dibenzoyl-) succinic ester and formylphenylacetic ester, addition of bromine occurs equally with the *cis-* and *trans*-forms; an internally complex copper salt, however, can only result from the *cis*-form, so that it is expected that the new method may render possible the recognition and isolation of *cis-* in the presence of *trans*-forms, provided that an instantaneous transformation of the geometrical forms is not induced by the copper acetate. H. W.

Iodometric Estimation of Acetone. P. H. HERMANS (*Chem. Weekblad*, 1921, **18**, 348).—The chief factor affecting the accuracy of the iodoform method for estimating acetone in aqueous solution is the amount of potassium hydroxide added; with either excess or deficiency, the results are not quantitative. For volumes of 20 c.c. and 100 c.c. of aqueous acetone, the necessary amounts

of 1·5*N*-potassium hydroxide are 10—15 c.c. and 25—30 c.c. respectively; the conversion is then complete in one to two minutes in the first, and in three to five minutes in the second case. W. J. W.

The Turner Reaction for Gurjun Balsam. J. B. LUTHER (*J. Assoc. Off. Agric. Chem.*, 1921, 4, 422—424).—The test described in the U.S. Pharmacopœia, and known as the Turner reaction for the detection of gurjun balsam in copaiba, is modified as follows in order to prevent the concentrated sulphuric acid charring the mixture and so obscuring the coloration. Four drops of the oil, 1 c.c. of glacial acetic acid, and 1 drop of 10% sodium nitrite solution are mixed and shaken with 2 c.c. of glacial acetic acid containing 5% by volume of concentrated sulphuric acid. If gurjun balsam is present, a violet coloration appears at once. Colorations which develop after the lapse of ten seconds are without significance. W. P. S.

Volumetric Estimation of Aniline by Diazotisation. TH. SABALITSCHKA and H. SCHRADER (*Zeitsch. angew. Chem.*, 1921, **34**, 45).—An aqueous solution containing about 1·5 grams of aniline in 100 c.c. is treated with an excess of sulphuric acid (at least 3 mols. of acid per mol. of aniline), cooled, and titrated with *N*/1-sodium nitrite solution. Potassium iodide–starch paper is used as an external indicator and the end point is denoted when a blue coloration persists for fifteen minutes after the last addition of nitrite. The reaction proceeds rapidly at first, but the velocity decreases considerably towards the end. About one hour is required for the titration. W. P. S.

Estimation of Urea. YNGVE FUNCKE (*Zeitsch. physiol. Chem.*, 1921, **114**, 72—78).—The solution of urea is treated with Millen's reagent; the gases evolved on warming the mixture are swept out of the reaction vessel by a current of carbon dioxide, passed through acid cupric chloride solution to absorb traces of nitric oxide, and led into a Schiff's nitrometer, where the volume of nitrogen is measured. C. R. H.

Direct Method for the Estimation of Dicyanodiamide. ERLING B. JOHNSON (*J. Soc. Chem. Ind.*, 1921, **40**, 125—126_T).—The method differs from the somewhat similar process advocated by Harger (this vol., ii, 224) in that it depends on the precipitation of the compound of dicyanodiamide (2 mols.) with silver picrate (1 mol.); urea and dicyanodiamidine do not interfere. When the sample under investigation contains 5—15% of dicyanodiamide nitrogen, 5 grams, or a correspondingly larger amount if less nitrogen is present, are placed in a 500 c.c. flask and 450 c.c. of water are added. If the sample is calcium cyanamide or other product containing lime, glacial acetic acid is added to bring all the lime into solution as acetate. By this means the nitrogenous compounds are dissolved much more rapidly and completely than without the acid, a small excess of which does not matter; stronger mineral acids isomerise the nitrogen compounds. The flask is shaken in a machine for three hours, the solution is made up to

500 c.c. and filtered; 5 c.c. of nitric acid (20%) are added to 100 c.c. of the filtrate followed by 20 c.c. of sodium picrate solution heated at 40° (7·5 grams of picric acid neutralised with sodium hydroxide and diluted to 100 c.c.). The solution is cooled to about 5° and titrated with *N*/22·4-silver nitrate solution, which is added drop by drop with constant shaking. About 2 c.c. more silver solution are used than is required by the amount of dicyanodiamide supposed to be present. The dicyanodiamide compound is precipitated in a more or less gelatinous form according to the amount of dicyanodiamide present. After being vigorously shaken, the mixture is allowed to remain with occasional agitation for fifteen minutes at 5°, after which it is diluted with cold water to 200 c.c., shaken, and filtered. The excess of silver solution used is estimated by titration with *N*/22·4-sodium thiocyanate in 100 c.c. of the filtrate after addition of a further 5 c.c. of nitric acid (20%) and about 2 c.c. of ferric sulphate solution (5%) as indicator. The influence of excess of silver nitrate and of varying amounts of nitric acid and calcium acetate has been investigated and it is found that, when working with calcium cyanamide, the use of 5 c.c. of nitric acid (20%) per gram of calcium acetate present and the addition of 2 c.c. excess of silver solution will give good results without any corrections, which, otherwise, depend largely on the personal equation. In the presence of chloride and soluble sulphides a blank test is necessary.

The formation of dicyanodiamide–silver complexes is not restricted to picric acid, but is typical of all nitrophenols which are soluble in water. *Compounds* of the silver salts of dinitrophenol, trinitroresorcinol, and trinitrocresol with one and two molecular proportions of dicyanodiamide have been isolated; of these, trinitroresorcinol appears to give a more nearly quantitative precipitation and better results than picric acid. H. W.

Reactions of Alkaloids with Silico- and Phospho-tungstic Acids. A. HEIDUSCHKA and L. WOLF (*Schweiz. Apoth.-Zeit.*, 1920, **58**, 213—218, 229—233; from *Chem. Zentr.*, 1921, ii, 840, 841).—The precipitates obtained with silicotungstic acid and dilute solutions of alkaloids are, with the exception of those from quinine and caffeine, of colloidal character; on addition of electrolytes, 1 to 3% hydrochloric acid, or alkali salts, or, in some cases, on keeping, flocculation takes place and they may be filtered. With silicotungstic acid in 0·01 *N*-solution in the presence of 1% of hydrochloric acid, sparteine, quinine, cinchonine, and nicotine give precipitates of the general formula,

$$SiO_2,12WO_3,2H_2O,2\text{Alkaloid}+\text{aq.},$$

whilst morphine, codeine, thebaine, and cocaine give precipitates of the general formula $SiO_2,12WO_3,2H_2O,4\text{Alkaloid}+\text{aq}$. In the cases of strychnine, brucine, narcotine, papaverine, colchicine, aconitine, and veratrine, the precipitates are more complex. With very small concentrations of electrolytes, the precipitates approximated to the second formula, but quantitative estimation was impossible owing to changes in composition on washing. Alkaloids the silico-

tungstates of which are only slightly altered by 0·1% sodium chloride solution can, in the absence of proteins, be estimated by treatment with a small excess of silicotungstic acid, standardised by sodium hydroxide and methyl-red, after addition of 1% sodium chloride. After filtering and washing, the excess of silicotungstic acid is titrated with sodium hydroxide and methyl-red.

Phosphotungstic acid behaves similarly with alkaloids. From 0·01*N*-solutions coniine and caffeine are precipitated in finely crystalline form. In the presence of less than 1% of hydrochloric acid, sparteine, quinine, cinchonine, and nicotine give precipitates of the general formula $2[P(W_2O_7)_6]H_7,3$Alkaloid+aq. The composition of the precipitates is influenced by the concentration of hydrochloric acid and by excess of phosphotungstic acid. The solubilities of alkaloid phosphotungstates and silicotungstates are affected in various ways by addition of hydrochloric acid and sodium chloride. Small amounts of alkaloids can be estimated nephelometrically, using the silicotungstates. G. W. R.

Colour Reaction for Aconite. S. MALLANNEH (*Analyst*, 1921, **46**, 193—194).—If a small crystal of potassium ferricyanide is placed close to a minute portion of aconitine or powdered aconite root and a drop of formic acid is added, a green coloration is obtained. The reaction is not given by morphine, atropine, digitaline, strychnine, eserine, or hyoscyamine. [Note.—The aconite mentioned appears to be the Indian variety, which contains ψ-aconitine but not aconitine.] W. P. S.

Estimation of Alkaloids in Cacao. ANTONIO CERIOTTI (*Anal. Soc. Quím. Argentina*, 1920, **8**, 400—403).—The material after removal of fat is treated with boiling 5% sulphuric acid. Colouring matters, tannins, and resins are removed by precipitation with 3% mercuric acetate and the filtrate after neutralisation with magnesia is evaporated to dryness with the addition of a little sand. The alkaloids (theobromine and caffeine) are then extracted, using a mixture of benzene and chloroform, and weighed. Caffeine can be separated by extracting the mixed alkaloids with carbon tetrachloride. [See also *J. Soc. Chem. Ind.*, 1921, 409A.]

G. W. R.

Estimation of Caffeine in Yerba Mate, Coffee, Tea, Kola Nut, and Guaraná. TRIFÓN UGARTE (*Anal. Soc. Quím. Argentina*, 1920, **8**, 413—415).—Caffeine is estimated in yerba mate, coffee, tea, kola nut, and guaraná by the following method. On heating a weighed quantity of the substance in a 500 c.c. Kjeldahl flask, caffeine is disengaged in white vapours, which, however, are not allowed to escape. After cooling and repeated treatment with water and filtration, the combined filtrates are evaporated to dryness and the residue is dissolved in 2 c.c. of water. The aqueous solution is shaken with chloroform, the chloroform solution separated by filtration, and evaporated to dryness. The residue is then extracted with water, and after evaporation, the caffeine dried at 100 to 105°, and weighed. [See also *J. Soc. Chem. Ind.*, 1920, 408A.]

G. W. R.

Chemico-toxicological Detection of Morphine. DOMENICO GANASSINI (*Boll. Chim. Farm.*, 1921, **60**, 2—5).—In the test given by Denigès for morphine (A., 1911, ii, 79), the copper sulphate and hydrogen peroxide may be replaced by potassium ferricyanide and ammonia, the reaction being then applicable to the detection of morphine in the blood and in non-putrefied organs of the body. It is found also that a dilute aqueous solution of blood is decolorised when treated under suitable conditions with ammonia and hydrogen peroxide, whereas in presence of morphine the original pink colour of the solution becomes more pronounced. Conditions are given for the application of the reaction of Denigès to the detection of morphine in the blood. The reaction is not given by either hydroxydimorphine, or the alkaloids accompanying morphine in opium, or by artificial derivatives of morphine, such as dionine and peronine. It is, however, distinctly given by heroine, notwithstanding Denigès's statement to the contrary; specific reactions are given for distinguishing heroine from morphine. [Compare *J. Soc. Chem. Ind.*, 1921, 446A.] T. H. P.

Estimation of Strychnine in Scale Preparations containing Quinine and other Cinchona Alkaloids. T. F. HARVEY and S. BACK (*Analyst*, 1921, **46**, 188—193).—The method recommended is a combination of Harrison and Gair's method (A., 1903, ii, 704; precipitation of quinine as tartrate with subsequent recovery of the strychnine) and Simmond's method (A., 1914, ii, 307). Ten grams of the sample are dissolved in 70 c.c. of water, 5 c.c. of $N/1$-sulphuric acid are added, the solution is nearly neutralised with ammonia, 30 grams of potassium sodium tartrate are added, and the mixture is again nearly neutralised with ammonia. The whole is heated at 100° for fifteen minutes, cooled, diluted to 100 c.c., and filtered after two hours. Fifty c.c. of the filtrate are rendered ammoniacal, extracted with chloroform, the chloroform solution is extracted with 10% (weight/volume) sulphuric acid, using 50 c.c. in all, and the acid solution is transferred to a separating funnel containing a plug of cotton-wool. Five c.c. of 4% potassium ferrocyanide solution are added and the funnel is filled with 10% sulphuric acid (to exclude air). After two hours, the liquid is drawn off through the cotton-wool filter, the strychnine ferrocyanide washed with 5% sulphuric acid, and then shaken with chloroform and ammonia. The chloroform extract is evaporated, the residue washed three times with 1 c.c. of ether, dried, and weighed. A correction of −1·7% is made to allow for the volume of the quinine tartrate precipitate. Quinidine and cinchonidine do not interfere; quinicine, if present in small quantity, may be removed by washing the strychnine residue twice with acetone, using 0·5 c.c. each time. W. P. S.

Estimation of Indigotin. WILLIAM THOMSON (*J. Soc. Dyers and Col.*, 1921, **37**, (6), 166—168).—A description of previous methods used for the estimation of indigotin is given. The author has devised a simplified process. One gram of the indigotin paste is dried on a watch glass, washed into a beaker with 30 c.c. of

ordinary sulphuric acid and heated at 50° for three hours. The product is cooled and diluted to one litre. Of this solution, 200 c.c. are diluted to one litre in a porcelain dish and titrated with an $N/50$-potassium permanganate solution until the liquid acquires a golden-yellow colour and shows a rim faintly tinged with pink. It is not strictly necessary to dry when 1 gram of indigotin paste is used, but an error of -0.3% occurs when 5 grams of undried paste are used for the sulphonation. It is important to use the same kind of illumination during the titration. When daylight and artificial light are used an error of 0.87% may occur. The presence of starch and glycerol (100% on weight of dry indigotin) leads to low results by Rawson's disulphonate and Bloxam's tetrasulphonate processes, but does not affect seriously the method now described. If, however, sulphonation is carried out at 90°, a dirty coloured solution is obtained and the end point cannot be determined within less than 8—10 drops. A. J. H.

Modification of the van Slyke Method of Protein Analysis. PAUL MENAUL (*J. Biol. Chem.*, 1921, **46**, 351—352).—Instead of precipitating the humin with calcium oxide, the former, ammonia, and some hexone bases are precipitated with phosphotungstic acid, and the phosphotungstates of the hexone bases dissolved by boiling. In the insoluble phosphotungstate, the ammonia is determined by distillation from alkaline solution, and the humin by a Kjeldahl determination of the residue, or better of the precipitate formed by adding sodium tungstate to an aliquot portion of the original hydrolysate. G. B.

Errors in the Detection of Albumin in Urine. E. RENAUX (*J. Pharm. Belg.*, 1921, **3**, 90; from *Chem. Zentr.*, 1921, ii, 869—870).—The presence of quinine can lead to the indication by Esbach's reagent of too high an albumin content. On the other hand the biuret test and the reactions with nitric acid, ammonium sulphate, and potassium ferrocyanide in acetic acid solution are rendered less sensitive. Sugar in urine must always be estimated by the use of Fehling's solution, since polarimetric estimations may be vitiated by the presence of lævulose. G. W. R.

Detection of Blood in Fæces. P. N. VAN ECK (*Pharm. Weekblad*, 1921, **58**, 723—727).—It has been shown (A., 1920, ii, 340) that a positive result with Adler's benzidine reaction does not necessarily denote the presence of blood. Evidence in confirmation of this conclusion is now adduced. W. J. W.

Estimation of Bilirubin in Blood Serum. C. HASELHORST (*Münch. med. Woch.*, 1921, **68**, 174—177; from *Physiol. Abstr.*, 1921, **6**, 130).—A colorimetric method of estimating the bilirubin content of 5 c.c. of venous blood. After separation of the corpuscles, the serum proteins are precipitated with alcohol. Bilirubin present then gives a violet-red coloration with Ehrlich's diazo-reagent. This may be compared with a Bordeaux red standard. E. S.

General and Physical Chemistry.

The Summation Method of Molecular Refraction, Particularly in the Case of Aromatic Hydrocarbons. A. L. VON STEIGER (*Ber.*, 1921, **54**, [*B*], 1381—1393).—Brühl's method of calculating the molecular refraction of organic substances is not completely satisfactory, since the results thereby obtained only agree approximately with the experimental values, whilst it also involves the effect of atomic and constitutive influences in a manner which cannot readily be justified from the physical point of view. The author has therefore applied to the calculation of molecular refraction the same considerations as were recently employed in calculating heats of combustion, definite refraction constants being assigned to the different bonds between the atoms [linking refraction constants], instead of to the separate atoms. A very satisfactory agreement is thus obtained between the calculated and experimental values, and it appears justifiable to conclude that all C–C and all C–H linkings in aromatic hydrocarbons are equivalent among themselves, but different from the corresponding values in the aliphatic series from the optical as well as from the thermochemical point of view. H. W.

The Influence of Constitution on the Dispersive Power of Optically Active Substances. XIII. [The Absorption Spectra of Optically Active Substances. H. RUPE, ALFRED KRETHLOW and KARL LANGBEIN (*Annalen*, 1921, **423**, 324—342. Compare A., 1911, ii, 450; 1912, ii, 1020; 1917, ii, 435).—In order to ascertain whether the phenomenon of anomalous rotation-dispersion is connected with the presence in the visible or in the near ultra-violet of an absorption band, the authors record the absorption curves for a number of optically active substances the rotation-dispersions of which are already known. The general conclusion drawn is that no such connexion can be substantiated.

The evidence on which this inference is drawn is as follows. Whilst it is true that *l*-menthyl acetoacetate, *l*-menthyl αα-diethylacetoacetate, *l*-menthyl benzoylacetate, ethyl camphorylideneacetate, $C_8H_{14}<\begin{matrix}CO\\ C{:}CH{\cdot}CO_2Et\end{matrix}$, camphorylacetic acid, $C_8H_{14}<\begin{matrix}CO\\ CH{\cdot}CH_2{\cdot}CO_2H\end{matrix}$, and 1 : 2 : 2 : 3-tetramethyl-1-methanol*cyclo*pentane exhibit both anomalous rotation dispersion and either slight or pronounced selective absorption, *l*-menthyl diacetoacetate, α-benzhydrylacetoacetate, α-benzylideneacetoacetate, α-benzylidenebenzoylacetate, α-benzoylphenylacetate, and pyruvate, and also 3-benzoyl-1 : 2 : 2 : 3-tetramethyl*cyclo*pentane, all of which show anomalous rotation dispersion, as well as camphorylideneacetone, $C_8H_{14}<\begin{matrix}CO\\ C{:}CH{\cdot}COMe\end{matrix}$, and *l*-menthyl α-benzylacetoacetate, in which cases the anomaly is

somewhat doubtful, are all devoid of any noteworthy degree of selective absorption; on the other hand, camphorylidenebenzylideneacetone, $C_8H_4<\begin{matrix}CO \\ C{:}CH{\cdot}CO{\cdot}CH{:}CHPh\end{matrix}$, and *l*-menthyl α-styrylbenzoylacetate show no anomalous rotation dispersion, but possess marked selective absorption. Clearly, therefore, the two phenomena occur independently of one another, at least in the main. C. K. I.

Mass Spectra of Chemical Elements. III. F. W. Aston (*Phil. Mag.*, 1921, [vi], **42**, 140—144. Compare A., 1920, ii, 344, 718).—The elements selenium, tellurium, iodine, antimony, and tin have been examined. Hydrogen selenide, tellurium methyl, methyl iodide, antimony hydride, and tin tetrachloride were used. No isotopes were found with any of these elements, although only the result with iodine is regarded as satisfactory. This is simple and of atomic weight 127. The work on xenon was repeated; trustworthy results were obtained for the five isotopes 129, 131, 132, 134, and 136, and two additional possible ones, 128 and 130, were discovered. Negative mass spectra of chlorine are described which confirm previous results with that element. J. R. P.

The Quantitative Sensitiveness of the Spectra of Silicon in Molten Salts and Steels. A. de Gramont (*Compt. rend.*, 1921, **173**, 13—17. Compare A., 1918, ii, 49).—Tables are given showing the rays which persist with decreasing amounts of silicon as silica in molten alkali carbonates and with decreasing amounts of silicon in steel. The ultimate rays of silicon in the former case are λ = 2881·6, 2516·1, and possibly 2524·1, which are apparent when as little as 0·005% of silicon is present. In the case of steels, the ultimate rays of silicon have disappeared when the silicon content has dropped to 0·03%, the ray λ = 2516·1 alone persisting with 0·05% of silicon. W. G.

Absorption and Series Spectra of Lead. J. C. McLennan and R. V. Zumstein (*Proc. Roy. Soc. Canada*, 1920, **14**, [iii], (9)).—Experiments were made to determine the absorption spectrum of non-luminous lead vapour. There is well-marked absorption at $\lambda\lambda$ 2833 and 2170 Å.U. The wave-length 2203·57 Å.U. was strongly enhanced in the spark spectrum. No absorption was observed either at 10291 Å.U. or at 10500 Å.U., indicated by the resonance and ionisation potentials, but it is probable that if any did occur it was masked by the strong radiation emitted by the furnace. An attempt was made to select wave-lengths which might belong to the series $n = (1{\cdot}5, S) - (m, P)$. It was not possible to select a series of wave-lengths which would fit exactly to a simple formula, but some regularities were noticed. The principal series, the sharp and diffuse subordinate series, and the enhanced series in the emission spectrum are considered. The line 2833·17 Å.U. is regarded as the first member of the series $n = (1{\cdot}5, S) - (2, p_2)$ and 2170·5 Å.U. as the first member of the real principal series $n = (1{\cdot}5, S) - (m, P)$. Besides λ 2203·57 Å.U., strongly enhanced

in the spark spectrum, two other wave-lengths were found, 1726·2 and 1555·8. J. R. P.

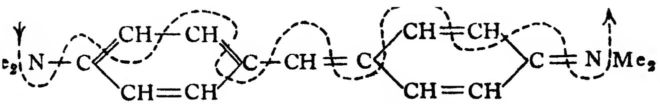
The Absorption Spectra of Europium and Samarium. WILHELM PRANDTL (*Zeitsch. anorg. Chem.*, 1921, **116**, 96—101).—The europium material used for previous experiments (A., 1920, ii, 721) has been again examined and subjected to further fractionation to separate it from the last traces of samarium, and it has been proved that the lines at λ 375 and 362, formerly attributed to samarium, are true europium lines. The europium line at λ 362 is much narrower and sharper than the samarium line in the same position. The absorption spectra of very pure specimens of europium and samarium nitrates have been photographed at concentrations ranging from 20 grams to 0·1 gram of the oxide per 100 c.c. Three new europium bands have been established, at 376·2—373·6, sharp on the red side, indistinct on the violet side, 367·2—365·5, very faint, and 363·7—361·7, very strong and sharp. Two new samarium lines were also discovered in the ultra-violet, at 355 and 345·5. The europium lines are in general much sharper than those of samarium. E. H. R.

The Principle of Combination and the Absorption Rays in *X*-Ray Spectra. A. DAUVILLIER (*Compt. rend.*, 1921, **173**, 35—38).—An extension of previous work (this vol., ii, 421) in which the author shows that the ray β''_7 of tungsten and the rare earths consists in reality of a doublet $\beta_7 = 733·5 \times 10^{-11}$ cm. and $\beta'_7 = 736·7 \times 10^{-11}$ cm. Further measurements of the rays γ_9, β_8, β_9, and $L\alpha_3$ are given. W. G.

The Electronic Structure of Heavy Atoms. L. DE BROGLIE and A. DAUVILLIER (*Compt. rend.*, 1921, **172**, 1650—1653).—A comparison of the physico-chemical indications concerning the electronic structure of the elements with the indications obtained from a study of their *X*-ray spectra. A recent spectrographic study (compare this vol., ii, 421) of the *L* series of uranium showed the absence of the *P*-ring. The anti-cathode was crystalline metallic uranium and the disappearance of the *P*-ring is explained on the hypothesis that the ions occupying the anticathodic focus must be in a very special state, in consequence of the very high local temperature existing there. This is borne out to some extent by recent work of Lilienfeld (compare *Physikal. Zeitsch.*, 1919, **20**, 280) and is similar to the hypothesis of Eddington with reference to the equilibrium of stars (compare *Scientia*, 1918, **23**). W. G.

Colour and Chemical Constitution. XII. Calculation of Colour from the Tautomeric Theory. JAMES MOIR (*Trans. Roy. Soc. S. Africa*, 1921, **9**, 205—216. Compare this vol., ii, 365).—The additive colour relationships previously deduced are attributed to the motion of an electron, traversing with the velocity of light and in a sinuous orbit the series of alternate and double linkings, of which the connexion with depth of colour has been previously indicated by Hewitt and Mitchell (T., 1907, 91, 1251) and by Watson and Meek (T., 1915, 107, 1567). The application of this

conception to the case of aqueous solutions of Michler's hydrol is represented by the diagram:



Additive values (indicated in brackets) are assigned to the tautomeric systems :C·CH:C:(103$\mu\mu$), :C·CH:O(94$\mu\mu$), :C·CH:NH(98$\mu\mu$), :C:CH·NMe_2(126$\mu\mu$) and to the modifications caused by substitution. These values are successfully applied to the cases of dihydroxybenzhydrol, benzaurine, diaminobenzhydrol, Doebner's-violet, Michler's hydrol, malachite-green, sodium phenoxide, aniline, sodium *o*- and *p*-hydroxybenzaldehyde, the phthaleins, the naphthalene analogues of all these compounds, indigotin, hydroxyazobenzene (as quinonephenylhydrazone) and its sodium salt, and aminoazobenzene, and also to aurine, pararosaniline, and crystal-violet, which have hitherto occupied an exceptional position. The cases of auramine, fuchsoneimonium chloride, and its dimethyl derivative, and the higher azo-dyes, however, still await an adequate explanation. J. K.

Constitution and Colour. VII. Theory of Quinonoid Organic Onium Salts. F. KEHRMANN (*Helv. Chim. Acta*, 1921, **4**, 527—537. Compare A., 1918, i, 311).—A theoretical paper in which fresh experimental material is not brought forward. Arguments are adduced and examples given to show that it is impossible at present to eliminate the quinonoid formulæ for the majority of dye salts, and that these are the most satisfactory expressions until it is possible to do justice simultaneously to Werner's and the quinonoid theory. H. W.

Mechanism of Photochemical Processes. ALFRED COEHN and HEINRICH TRAMM (*Ber.*, 1921, **54**, [*B*], 1148—1151).—An examination of the influence of pressure and degree of desiccation on the explosibility of mixtures of carbon monoxide and oxygen has shown (1) that a moist mixture can be exploded by a spark at any pressure; (2) that a mixture, dried by short exposure to the action of solid carbon dioxide and alcohol, cannot be exploded but inflames and burns quietly, and (3) that a mixture which has been cooled for a sufficient time cannot be inflamed; a pale blue zone forms round the spark gap and slight combination is indicated by a small diminution of pressure. Exposure of mixtures belonging to the three types to ultra-violet rays of a quartz mercury lamp leads to practically the same result in each case, combination occurring to the extent of 4—5% within an hour. It follows, therefore, that the presence of aqueous vapour does not play a part in the union of carbon monoxide and oxygen under the influence of radiant energy. The reason of the markedly restrictive action of aqueous vapour on the decomposition of carbon dioxide in ultra-violet light is not to be found in the inability of carbon

monoxide and oxygen to combine on exposure to light in the absence of moisture. H. W.

The Photo-chemistry of Lead Compounds. Carl Renz (*Zeitsch. anorg. Chem.*, 1921, **116**, 62—70).—Lead chloride darkens when exposed for a long time to intense light. The sensitiveness depends to some extent on the method of preparation; lead chloride crystallised from hot hydrochloric acid blackens relatively quickly. Dilute nitric acid does not remove the colour, and it appears that a lead photochloride is formed. When lead oxide is exposed to light under water, a partial reduction to metallic lead occurs, whilst the oxygen set free oxidises part of the lead oxide to peroxide, and this in turn combines with lead oxide to form plumbate. The metallic lead is reoxidised by air contained in the water. The formation of metallic lead was proved by exposing to light a mixture of lead oxide and lead chloride which had been boiled with hydrochloric acid. When the product was treated with dilute nitric acid, lead was dissolved with evolution of hydrogen and a slight residue of peroxide remained. There was no evidence of formation of oxychlorides of lead. It is suggested that compounds of the different lead isotopes may be differently affected by light, and the same may be the case with silver and thallium compounds. A possible method of separating isotopes is indicated. E. H. R.

The Catalytic Action of Electrolytes on the Photolysis of Eder's Solution. G. Berger (*Rec. trav. chim.*, 1921, **40**, 387—393).—Previous experiments formed the basis of an hypothesis for the existence of a photochemical effect of electrolytes, of a catalytic nature, produced by the electrostatic forces of ions, in solutions in which reactions occur under the influence of light (compare A., 1920, ii, 725). Further experimental results taken in conjunction with the previous results indicate that the theories of Roloff (A., 1894, ii, 221) and Winther (A., 1909, ii, 283) do not offer an adequate explanation of the catalyses by salts in Eder's solution. The author prefers the theory of the existence of an effect of electrolytes, there being probably a relation between the forces producing this effect and the interionic forces of Miller (*Phil. Mag.*, 1912, [vi], **23**, 551), Hertz (A., 1912, ii, 120), and Bjerrum (A., 1919, ii, 9). W. G.

Photocatalysis. I. The Synthesis of Formaldehyde and Carbohydrates from Carbon Dioxide and Water. Edward Charles Cyril Baly, Isidor Morris Heilbron, and William Francis Barker (T., 1921, **119**, 1025—1035).

The Intensity of Reflection of *X*-Rays by Rock-salt. II. W. L. Bragg, R. W. James, and C. H. Bosanquet (*Phil. Mag.*, 1921, [vi], **42**, 1—17. Compare *ibid.*, **41**, 309).—Experiments are described for the determination of the amplitude of the wave diffracted in various directions by the chlorine and sodium atoms when homogeneous X-rays of unit amplitude fall on these atoms in a crystal of rock-salt. The amplitude is expressed in terms of that diffracted

by a single electron. The results indicate the correct number of electrons in the atoms of sodium and chlorine. J. R. P.

Rutherford's Discovery of a New Light Atom Nucleus. ADOLF SMEKAL (*Naturwiss.*, 1921, 9, 77—82, 93—98; from *Chem. Zentr.*, 1921, iii, 2—3. Compare A., 1920, ii, 541).—A discussion and criticism of Rutherford's discovery of the helium isotope X_3. G. W. R.

Probable Normal State of the Helium Atom. EDWIN C. KEMBLE (*Phil. Mag.*, 1921, [vi], **42**, 123—133).—The model of the helium atom proposed by Franck and Reiche (A., 1920, ii, 656) provides no explanation of the chemical properties of helium, gives the wrong ionisation potential, and does not harmonise with the observations of Fricke and Lyman (this vol., ii, 362) on the ultraviolet emission spectrum of helium. The facts regarding the excitation of the various lines in the arc spectrum of helium show that the only stationary states from which direct passage to the normal state is ordinarily possible are those from the series (m, S); that the direct transfer of atoms from the states (m, S) to the normal takes place with relative difficulty; and that the presence of some common impurity in helium provides an indirect path for the return of atoms to the normal state which is accompanied by the emission of more than one radiation frequency. The resulting angular momentum of the normal helium atom, on Bohr's theory, would be zero. Neither of two possible models having zero angular momentum is very satisfactory, and it is possible that Bohr's principle applied to the atoms returning to the normal state may have to be abandoned. A symmetrical model with one unit of angular momentum is suggested as a possible solution of the problem. J. R. P.

Mobilities of Ions in Helium at High Pressure. J. C. MCLENNAN and E. EVANS (*Proc. Roy. Soc. Canada*, 1920, **14**, [iii], 19–26).—Pure helium at high pressures does not exhibit any appreciable metallic conductivity. The mobilities of positive and negative ions produced in helium at 81 atm. pressure by α-rays from polonium were found to be $2{\cdot}52 \times 10^{-2}$ and $4{\cdot}26 \times 10^{-2}$ cm. per sec. per volt per cm., respectively. They do not vary inversely with the pressure at high pressures. J. R. P.

A New Radioactive Substance in Uranium. OTTO HAHN (*Ber.*, 1921, **54**, [*B*], 1131—1142).—It is found that a new radioactive substance possessing the chemical properties of protoactinium is present in ordinary uranium salts. It emits β-radiations and has a half life period of six to seven hours. The radiations are highly complex; within the limits examined, the halving thickness increases from 0·014 to 0·12 mm. of aluminium. Under the prescribed conditions, the intensity of radiation of the new substance is only about 0·25% of that of uranium-X (uranium-X_1 + uranium-X_2) obtained from the same quantity of uranium. The parent substance can only be uranium-X_1 or a new uranium-X_1 isotope of similar life period. In the former case, uranium-X_1

suffers a dual degradation of a type which has not been observed previously among radio-elements. In the latter case it is probable that a new uranium degradation series exists which has a small intensity of radiation and the individual members of which can be arranged as isotopes in the known uranium–radium series. Until the parentage of the new substance is definitely established, the author proposes to designate it uranium-*Z*.

The substance is isolated in the following manner, since it is found that under the usual conditions uranium-*Z* invariably accompanies uranium-*X*. Enrichment in the latter is affected by a few fractional crystallisations of the uranium nitrate from water whereby the active materials remain in the mother-liquors. Iron chloride is added to the latter and the iron, carrying the uranium-*X* and uranium-*Z* with it, is precipitated by the addition of ammonia and ammonium carbonate. The iron precipitate is treated with a solution of tantalum in hydrofluoric acid, lanthanum nitrate is added, and the mixture is digested on the water-bath for a considerable time with dilute sulphuric and hydrofluoric acids. The lanthanum together with uranium-*X* is thereby precipitated as the insoluble fluoride. The filtrate is evaporated and the residue gently ignited, whereby the tantalum precipitate becomes insoluble in acid whilst the iron precipitate remains soluble. The latter is brought into solution by concentrated hydrochloric acid and the residue is warmed for some time with aqua regia and filtered after being diluted. The tantalum remains on the filter in a perfectly colourless condition. Uranium-*Z* remains almost completely with the tantalum, only small quantities being generally found with the iron precipitate; both, however, retain small amounts of uranium-*X*, which, however, can be almost completely eliminated by a second treatment of the iron-tantalum solution with lanthanum nitrate. It is thus possible to obtain specimens of uranium-*Z* which are 99·5% radioactively pure, only about 0·5% of the activity being due to uranium-*X*. H. W.

Origin of Uranium-Z_2 (Uranium-Z). M. C. NEUBURGER (*Naturwiss.*, 1921, **9**, 235—236; from *Chem. Zentr.*, 1921, i, 1015).—Supplementary to the work of Hahn (see preceding abstract), the author describes three possible types of disintegration in the radium–uranium series to account for the occurrence of the newly-discovered uranium-*Z*. The existence of two new elements thereby follows, namely, uranium III in Group VI, giving α-rays, and uranium-*Z* in Group IV, giving β-rays. Besides the transformations due to the emission of ordinary α-rays, there are others due to Rutherford's helium isotope, X_3, which are termed *iso*-α-particles. G. W. R.

Origin of Uranium-Z. OTTO HAHN (*Naturwiss.*, 1921, **9**, 236; from *Chem. Zentr.*, 1921, i, 1015).—The author rejects the possibility of the transformations suggested by Neuburger (preceding abstract) as improbable and lacking experimental foundation. G. W. R.

Thermal and Electric Conductivities of Metals. WALTHER MEISSNER (*Jahrb. Radioaktiv. Elektronik*, 1920, **17**, 229—273).—A summary of recent work on the subject. J. R. P.

Electrical Conductivity in Solid Crystallised Compounds. III. The Electrical Conductivity of Silver Sulphide and Cuprous Sulphide. C. TUBANDT, SOPHIE EGGERT, and GUSTAV SCHIBBE (*Zeitsch. anorg. Chem.*, 1921, **117**, 1—47).—The methods described in previous papers (A., 1920, ii, 279; this vol., ii, 426) have been used for the investigation of the electrical conductivity of silver sulphide and cuprous sulphide, to settle the debated question whether these are metallic or electrolytic conductors. The conduction of silver sulphide between metallic electrodes is interfered with by the rapid growth of a metallic bridge between the electrodes. This difficulty was overcome, as in previous work, by interposing between the small cylinder of silver sulphide and the platinum cathode a cylinder of silver iodide, using a silver anode. The α-form of silver sulphide, stable above 179°, was found to be a pure electrolytic conductor, following Faraday's law perfectly. The current is carried entirely by the silver ions with the high migration velocity of 0·11 cm. per sec. The form of silver sulphide stable below 179°, however, was found to be a mixed conductor, about 80% of the current being carried by the silver kations, the remainder being conveyed as in a metallic conductor. For the ingenious experimental method by which this result was obtained, the original must be consulted. The proportion of the current carried electrolytically is influenced to some extent by the presence of impurities in the silver sulphide, by the temperature, and by the current strength. The lower limit of temperature for the experiments was 145°, the transition point of silver iodide, since only the cubic form of this substance is effective in preventing metallic short-circuiting. The proportion of metallic conduction was found to increase with falling temperature and with increasing current strength.

Only the high temperature form of cuprous iodide could be investigated, as its transition point, 91°, is below that of silver iodide. After many experimental difficulties had been overcome, it was shown that the cubic form of cuprous iodide is a pure electrolytic conductor, the current being carried solely by the cupro-ions. E. H. R.

Electrical Conductivity in Solid Crystallised Compounds. IV. The Electrical Conductivity of Solid Silver Sulphide–Silver Mixtures. C. TUBANDT and SOPHIE EGGERT (*Zeitsch. anorg. Chem.*, 1921, **117**, 48—58).—When a current is passed through a solid cylinder of a mixture of silver sulphide and silver, using a silver anode and platinum cathode with a cylinder of silver iodide between the cathode and the solid electrolyte (compare preceding abstract) above 179°, the amount of silver dissolved from the anode is not in agreement with Faraday's law, although at this temperature silver sulphide is a pure electrolytic conductor. It is found, however, that if the electrolysis is continued for a

sufficient length of time, the whole of the silver in the silver sulphide gradually wanders to the cathode, leaving eventually pure silver sulphide which then behaves as a pure electrolytic conductor. This phenomenon can be utilised to free silver sulphide from silver, and also provides a method of proving the formation of a silver bridge when silver sulphide is electrolysed between metal electrodes. It also verifies the results of other workers that silver and silver sulphide do not form mixed crystals, but a coarse mechanical mixture. The experiments were made with mixtures containing up to about 13·5% of silver. E. H. R.

Electrical Conductivity and Density of Aqueous Solutions of Electrolytes. ADOLF HEYDWEILER (*Zeitsch. anorg. Chem.*, 1921, **116**, 42—44).—The results of conductivity and density measurements of aqueous solutions of about sixty metallic salts of inorganic and organic acids are given in tabular form. E. H. R.

Influence of Forging on the Electrical Resistance of Steel. EUGÈNE L. DUPUY (*Compt. rend.*, 1921, **172**, 1660—1662).—When a bar of steel is drawn into wire the electrical resistance decreases as the section diminishes. During the wire-drawing the zones of perlite and ferrite distributed without orientation in the bar become aligned and elongated into filaments with a consequent diminution in the resistance. If such wire is heated to 800° and cooled at a suitable velocity the alignment disappears and the micrographic structure becomes similar to that of the original bar. The variation in the resistance, however, persists although sensibly lessened. It is shown that the wire contains, even after annealing, iron oxide in solution and a part of the resistance of the metal is due to the presence of this oxide. W. G.

Overvoltage. I. A Comparison of the Methods of Determination, especially as Applied to the Mercury Cathode. SYDNEY DUNNILL (T., 1921, **119**, 1081—1088).

Nature of Chemical Forces and the Anomaly of Strong Electrolytes. WILLIAM HUGHES (*Phil. Mag.*, 1921, [vi], **42**, 134—138).—On the assumption that interionic forces in solutions of electrolytes are inverse-square functions of the distances apart of dissimilar ions, and that the forces causing dissociation of molecules are inverse higher power functions of the distance, a quantitative theoretical interpretation of the Rudolphi dilution law and a qualitative interpretation of the van't Hoff dilution law are given. J. R. P.

The Theory of Electrolytic Ions. XXII. The Migration Velocity of some Ions. A Second Test of Paul Hertz's Theory of Ion Conductivity. RICHARD LORENZ and WILHELM NEU (*Zeitsch. anorg. Chem.*, 1921, **116**, 45—61).—Applying von Laue's theory of ionic mobility (A., 1916, ii, 289) an experimental method was devised for measuring the velocity of migration of ions by measuring the displacement of the surface separating two

solutions, one of which contained a coloured ion to serve as indicator, when electrolysed. Measurements were made at 18° and 25°, at dilutions from 1/4 to 1/2048*N* for the MnO_4', BrO_3', IO_3', ClO_3', and F' ions. The relation between ionic mobility and concentration, in all cases except that of the iodate ions, which gave abnormal results, confirmed the applicability of Hertz's theory of ionic conductivity. The value of Hertz's *A*-constant found was 9·1 at 18°, which agrees with that found by Lorenz and Osswald from measurements of the conductivity of sodium acetate (this vol., ii, 158), but does not correspond with the theoretical value, 18·9. No conclusion could be drawn from the experiments regarding the completeness of dissociation of strong electrolytes. E. H. R.

The Theory of Electrolytic Ions. XXIII. The Conductivity of some Binary Electrolytes. Third Test of Paul Hertz's Theory of Conductivity. RICHARD LORENZ and WILHELM MICHAEL (*Zeitsch. anorg. Chem.*, 1921, **116**, 161—182).—The electrical conductivities of potassium permanganate, potassium chloride, sodium chloride, sodium bromide, and potassium bromide were redetermined at 25° at dilutions from 1/8 to 1/2048*N*. The ion mobilities were calculated, making use of the direct determination of the mobility of the MnO_4' ion by Lorenz and Neu (preceding abstract). The greater part of the paper is devoted to a discussion of the Hertz function (compare this vol., ii, 158, and A., 1912, ii, 120) and to the development of a graphic method for calculating the constants of the Hertz formula. The values obtained for Hertz's so-called universal constant, calculated from the ionic mobilities found in the present series of experiments, confirm the conclusion that the constant is not universal, but has a particular value for each ion. Experimental errors may affect seriously the values found for the constant, but such errors are not likely to cause variations so large as those actually observed. E. H. R.

The Theory of Electrolytic Ions. XXIV. The Conductivity of some Neutral Sodium Salts of Polybasic Organic Acids. RICHARD LORENZ and A. SCHEUERMANN (*Zeitsch. anorg. Chem.*, 1921, **117**, 121—139).—The molecular conductivities of the neutral sodium salts of oxalic, malonic, succinic, benzoic, phthalic, *iso*phthalic, terephthalic, pyromellitic, and mellitic acids at 25° for a wide range of dilutions were measured, with the object of determining how the different stages of dissociation would affect the conductivity with increasing dilution. When the conductivities as ordinates were plotted against $\sqrt[3]{c}$, where *c* is the concentration, the curves obtained in the case of salts of mono- and di-basic acids were approximately straight lines between the concentrations 1/1024 and 1/64, but at higher concentrations the curves were deflected upwards. The curves for salts of acids of higher basicity were not straight over any part of their course. In the case of salts of aliphatic dibasic acids, the part of the curve which is deflected when $\sqrt[3]{c}$ is used becomes straight if $\sqrt[4]{c}$ is chosen instead. A graphic method is described for determining the limiting con-

ductivity, which consists in plotting the conductivity against $\sqrt{c}$, $\sqrt[3]{c}$, and $\sqrt[4]{c}$ and determining the probable point of intersection of the curves thus obtained at zero concentration. E. H. R.

The Theory of Electrolytic Ions. XXV. The Apparent Size of the Anions of some Aliphatic and Aromatic Poly-carboxylic Acids and of Benzene. RICHARD LORENZ and A SCHEUERMANN (*Zeitsch. anorg. Chem.*, 1921, **117**, 140—146).—The radii of anions of the arsinic acids and their salts, calculated by Stokes's law from the ionic mobilities and space-filling numbers (A., 1920, i, 897) were found to lie between the values found for the benzene radius by Debye and by Steiger (A., 1920, ii, 355). The ionic mobilities of the anions and hence their radii have now been calculated from conductivity measurements of the sodium salts of oxalic, malonic, succinic, benzoic, phthalic, *iso*phthalic, terephthalic, pyromellitic, and mellitic acids. In the series of dibasic aliphatic acids the ionic radius increases as the homologous series is ascended, whilst the mobility decreases. In the case of the aromatic anions, the radius increases with increasing number of carboxyl groups, and is greater the more symmetrical the molecule. The mobility v/σ, where v is the calculated mobility and σ the number of carboxyl groups, decreases as the number of atoms in the ion increases. The ionic radii all fall between the values for benzene given by Debye and Steiger respectively. The possible configurations of the aromatic anions are discussed. E. H. R.

Photoelectric Investigations with Salt Solutions. II and III. TORSTEN SWENSSON (*Arkiv Kem. Min. Geol.*, 1920, **7**, No. 25, 1—7. Compare A., 1920, ii, 409).—The author has made experiments with the object of ascertaining if the alteration of *E.M.F.* occasioned by the ultra-violet illumination of salt solutions may be due to the formation of hydrogen peroxide. The unimolecular character of the decomposition of hydrogen peroxide in water and in nickel sulphate solution (compare Tian, A., 1911, ii, 35; 1915, ii, 828; Henri and Wurmser, A., 1913, ii, 744, 819; Mathews and Curtis, A., 1914, ii, 255, 602) is confirmed. The decomposition is slower in nickel sulphate solution than in water, and in either case the position of equilibrium, if such is actually reached, corresponds with a very low concentration of the peroxide. With reference to Thiele's statement that hydrogen peroxide is formed by the illumination of water (A., 1908, ii, 79), the author finds that if this is the case the peroxide is not obtained in a proportion detectable chemically. As regards the velocity of decomposition of hydrogen peroxide in the dark, this is not increased by previous illumination of the salt solution, the rapid decomposition ending immediately the illumination ceases.

Measurement of the effect on the *E.M.F.* of a nickel sulphate and a potassium sulphate element produced by addition to the solutions of hydrogen peroxide shows that, even were the peroxide formed in a proportion not detectable analytically, it could not be the cause of the alteration in *E.M.F.* resulting from illumination.

The temperature in the author's experiments varied by $\pm 1°$,

but the effect of illumination is in the opposite sense to that of rise of temperature and also greatly exceeds that involved in a rise or fall of temperature of 1°. T. H. P.

Magnetism and Atomic Structure. O. VON AUWERS (*Jahrb. Radioaktiv. Elektronik.*, 1920, **17**, 181—229).—A summary of recent work on the magnetism of elements, compounds, and alloys, from the point of view of theories of atomic magnetism. J. R. P.

Relation between the Anomalous Dilatation and the Thermal Variation of Magnetisation of Ferromagnetic Substances. P. CHEVENARD (*Compt. rend.*, 1921, **172**, 1655—1657).—To interpret the action of temperature on the properties of ferromagnetic substances the author has previously formulated an hypothesis of a progressive and reversible transformation of a form α, stable at absolute zero, and an isomorphous form β, stable at high temperatures. At all temperatures, θ, the state of the substance can be characterised by the proportion, x, of the form α. It is now shown that the quantity x is sensibly proportional to the square of the magnetisation at saturation, I^2, in the whole of the temperature range below the Curie point. Further, it is admitted that $x=(V-V_\beta)/(V_\alpha-V_\beta)$ where V, V_α, and V_β are the specific volumes of ferronickel and its two components α and β respectively at any temperature. W. G.

Critical Energy Increment and Trouton's Rule. ERIC K. RIDEAL (*Phil. Mag.*, 1921, [vi], **42**, 156—163).—The critical energy increment is an average value, and the equilibrium between molecules of any one species in various stages of activation is assumed to follow the energy curve of the surrounding radiation. Only in the case of "black" molecules is the curve complete. At the critical temperature the maximum number of molecules is activated for the reaction of condensation to a non-polymerised liquid. Since the latent heat of evaporation is given by $L=Nh\nu$, Trouton's constant is, on the above hypothesis, merely an approximate expression of Wien's displacement law $\lambda_m T=$const. The value of the constant calculated from radiation data agrees closely with experiment: $\lambda_m T_c=0{\cdot}28986$; $\nu=c/\lambda_m$; $\therefore L=Nh\nu=NhcT_c/0{\cdot}28986=9{\cdot}866T_c$. J. R. P.

Number of Atoms and the Physical Behaviour of Organic Liquids. W. HERZ (*Zeitsch. anorg. Chem.*, 1921, **116**, 250—254. Compare Jorissen, A., 1920, ii, 90).—It was shown by Groshans that, for organic liquids containing carbon, oxygen, and hydrogen, if n is the number of atoms, M the molecular weight, T_s the absolute boiling temperature, and d_s the density at the boiling point, $n=193M^2/T_s^2d_s$. Combining this equation with the relation $n=1{\cdot}1T_c/p_c$ (A., 1920, ii, 285) and Trouton's rule, it is shown that $M/T_s^2=0{\cdot}00077$. This relation is found to hold with approximate accuracy for a series of seventy-nine compounds with boiling points ranging between that of ethane ($T_s=187{\cdot}6$) and that of anthraquinone ($T_s=653$). Combining Groshans's equation with the relation $v_c=0{\cdot}0009n$, it is shown that $v_c=0{\cdot}1737M^2/T_s^2d_s$, or, combining the latter with

$M/T_s^2=0.00077$, $v_c=1.34\times10^{-4}M/d_s$. The values of v_c calculated from both these formulæ for a number of esters of fatty acids agree well with the observed values. The relation between specific heat, s, and critical data for the higher paraffins can be expressed by the equation $sM=2.44T_c/p_c$. Relationships are also found between the molecular heats and the molecular refractions and heats of vaporisation respectively of the paraffins from pentane to decane. E. H. R.

Total Heat of Liquid Carbon Dioxides. C. Frewen Jenkin and D. N. Shorthose (*Proc. Roy. Soc.*, 1921, **99**, [*A*], 352—361).—In a previous paper (A., 1915, ii, 741) a curve giving the total heat of carbon dioxide was given which was based on the assumption that the value of C_v is constant and equal to 0·214. The present paper describes the determination of the total heat of carbon dioxide, the object being to check the earlier results. Measurements were made at 12° and 100° and at pressures 900, 1000, 1100, 1200, 1300, 1500, and 1800 lb./sq. in. The values have been calculated for every 5° from 0° to 100° for each pressure from a smooth curve drawn through the experimental values. The present work indicates that C_v is not constant, but the data obtained are insufficient for an accurate calculation of this value. J. F. S.

High Temperature Investigations. XIII. The Measurement of Vapour Pressures at High Temperatures and the Vapour Pressures of the Alkali Haloids. Otto Ruff and Susanne Mugdan (*Zeitsch. anorg. Chem.*, 1921, **117**, 147—171).—Experiments were made primarily to test the experimental method for the determination of vapour pressures at high temperatures described by Ruff and Bergdahl (A., 1919, ii, 265). It was found very important that the material of which the crucible is made should be adapted to the substance under examination. Only substances such as metals with high surface tension can be vaporised in carbon or graphite crucibles. For substances with small surface tensions, thick-walled, optically black vessels must be used, such as blackened quartz. For metals, the volume of the crucible should be not more than 0·2 c.c., whilst for salts and similar substances it should be about 0·6 to 0·7 c.c. The optical pyrometer should be directed on to the blackened vessel. If the substance has a heavy vapour which might interfere with the readings of the optical pyrometer, this must be guarded against by passing as rapid a current of gas as possible. The vapour pressures of arsenic, antimony, bismuth, and copper were redetermined in the light of new experience, and in all cases except that of arsenic the former results were confirmed. For arsenic, the former temperature readings were found to be 20—40° too low.

The vapour pressure curves of the haloids of the alkali metals were determined, with the exception of the fluorides, for which a suitable crucible material could not be found. In general the vapour pressure decreases with increasing atomic weight of the components, except in the case of the lithium salts. As the atomic weight of the alkali metal increases, the influence of the halogen

on the vapour pressure becomes less. The following boiling points at atmospheric pressure were found: lithium chloride, 1337°, bromide, 1265°, iodide, 1189°; sodium chloride, 1442°, bromide, 1396°, iodide, 1299°; potassium chloride, 1415°, bromide, 1388°, iodide, 1319°; rubidium chloride, 1388°, bromide, 1340°, iodide, 1304°; cæsium chloride, 1289°, bromide, 1297°, iodide, 1280°. From the data obtained, the heats of vaporisation and critical temperatures were calculated for the salts. The relation between vapour pressure and absolute temperature is in fair agreement with the Ramsay-Young rule for all the salts. E. H. R.

High Temperature Investigations. XIV. The Vapour Pressures of the Oxides of Silicon, Aluminium, Calcium, and Magnesium. OTTO RUFF and PAUL SCHMIDT (*Zeitsch. anorg. Chem.*, 1921, **117**, 172—190).—The experimental method described in a previous paper (A., 1919, ii, 265) was made use of in an attempt to determine the vapour pressures at high temperatures of silica, alumina, lime, and magnesia. With silica and alumina, satisfactory results were obtained, after many experiments, using a graphite crucible glazed with vanadium carbide, which melts at 2850°, and, when mixed with vanadium oxide, gives a fairly dense glaze resistant up to 2400°. The boiling points of silica and alumina at 760 mm. are both about 2210° to 2230°. Most of the experiments were made in an atmosphere of nitrogen, but the results obtained in a few cases in which argon was used indicated that nitrogen might have a disturbing influence, especially in the case of lime. The experiments with lime and magnesia were unsatisfactory, except at low pressures, on account of chemical action between the oxide and the crucible. The results indicated, however, that the boiling point of lime at 760 mm. is near 2850° and that of magnesia near 2800°. E. H. R.

Fused Salts and the Law of Corresponding States. RICHARD LORENZ and W. HERZ (*Zeitsch. anorg. Chem.*, 1921, **117**, 103—110).—In his work on the temperature coefficient of free molecular surface energy (A., 1917, ii, 69, 70, 71), Jaeger expresses the opinion that fused electrolytes do not follow the law of corresponding states. The authors contradict Jaeger's opinion from his own data. He gives the fusion points, T_e, for a large number of salts, and also the temperature, T_2, at which vapour begins to form with great rapidity. The latter temperature is below, but not far removed from, the boiling point. The ratio T_e/T_2 is found to be approximately constant for all the salts, the mean value being 0·74, whilst, by the law of corresponding states, the ratio of the melting to the boiling point is 0·68. It is concluded, therefore, that the law can be applied to fused salts, and accordingly the boiling points, T_s, of the salts were calculated from the melting points from the equation $T_e/T_s = 0{\cdot}68$. Jaeger also determined the relation between density and temperature for the fused salts, and by extrapolation from his results, the density, d_s, at the calculated boiling point was calculated. The ratio d_e/d_s was then calculated for the salts, and the mean value found was 0·864, the corresponding value for liquids which

follow the law of corresponding states being 0·855. The critical temperatures, critical densities, and densities at absolute zero of the salts were also calculated, assuming them to obey the same law.

E. H. R.

The Heats of Formation of Glucinum Oxide and Chloride. W. MIELENZ and H. VON WARTENBERG (*Zeitsch. anorg. Chem.*, 1921, **116**, 267—268).—The heat of formation of glucinum chloride was determined by the direct combination of the metal and chlorine, and was found to be 112·6±0·4% cal., whilst Pollak (T., 1904, **85**, 604) found 155 cal. by measuring the heat of solution of the metal in hydrochloric acid. The new figure is more probably correct, as it lies on a smooth curve obtained by plotting heats of formation against atomic weights in the series Gl, Mg, Ca, Sr, Ba. The heat of formation of glucinum oxide was also determined by direct combination in a bomb calorimeter and was found to be 135·9±0·9% cal. This value also falls on a smooth curve with the heats of formation of other oxides of the glucinum group. E. H. R.

A Linear Relation for certain Atomic Volumes. WILHELM BILTZ (*Zeitsch. anorg. Chem.*, 1921, **117**, 84—90).—In a previous paper (this vol., ii, 437) it was shown that there is a linear relation between the densities of a large number of corresponding chlorine, bromine, and iodine compounds and those of the haloids of the alkali metals. It is now shown that this relationship is intimately connected with the position of the alkali metals and halogens in the periodic system on either side of the rare gases. Between the atomic volumes of argon, krypton, and xenon, on the one hand, and of chlorine, bromine, and iodine on the other, there is strict proportionality, in the sense that $A.V._{\text{Halogen}}=a\times A.V._{\text{Rare gas}}$, where $a=0{\cdot}8015$. The relation between the atomic volumes of the alkali metals and of the rare gases preceding them is also linear, the equation being $A.V._{\text{Alkali metal}}=a\times A.V._{\text{Rare gas}}+b$, where $a=1{\cdot}823$ and $b=-6{\cdot}10$. A similar relation holds for the elements silicon, germanium, and tin, preceding the rare gases, and titanium, zirconium, and cerium, following the rare gases, but for no other group of elements. The relation holds, therefore, only between elements having the electron valencies, 0, ±1, and ±4. The linear relation previously found between the molecular volumes of the alkali haloids is, therefore, an expression of their atomic structure. That a similar relation holds for more complex halogen compounds is probably due to the relatively large volume of the halogen atom compared with that of the rest of the molecule. There is a similar linear relation between the absolute boiling points of the halogens and of the rare gases. E. H. R.

Polymerisation in the Solid State; Polymerisation amongst Liquids. WILLIAM R. FIELDING (*Chem. News*, 1921, **122**, 13—17; 289—293; **123**, 1—5. Compare A., 1920, ii, 732).—The molecular weight is calculated from the formula $PWS=9$, where P=polymerisation factor, W=average atomic weight of the atoms composing the compound, S=specific heat. The formula is

applied to several solids and liquids. The results show that saturated hydrocarbons are highly but nearly equally polymerised near their boiling points; unsaturated hydrocarbons are less polymerised; the introduction of hydrogen into the benzene ring increases the polymerisation; the introduction of a side chain scarcely affects P; the introduction of halogens reduces P; on replacing one hydrogen atom in water by an organic radicle P is considerably increased, the increment due to CH_2 being approximately independent of temperature; *iso*alcohols are less polymerised than normal alcohols, but the two approach at the boiling point; the polymerisation of organic acids increases with the percentage of carbon and is less than that for the corresponding hydrocarbons; nitriles are slightly more polymerised than acids. J. R. P.

Surface Tension of Unimolecular Layers. A. MARCELIN (*Compt. rend.*, 1921, **173**, 38—41).—It has previously been shown (*Ann. Physique*, 1913) that any further quantity of oleic acid placed on water already covered with a layer of a thickness practically double that which corresponds with the maximum extension does not undergo spontaneous extension, but remains in the state of small or large globules: the layer may then be considered as saturated. Further measurements with oleic acid, *iso*butylborneol, and gum have confirmed this discontinuity. If the surface occupied by a given quantity of oleic acid is progressively reduced, the tension decreases and then suddenly becomes constant. The saturation pressure of the layer is the constant difference of surface tensions between pure water and water covered with a saturated layer. W. G.

Properties and Molecular Structure of Thin Films of Palmitic Acid on Water. I. N. K. ADAM (*Proc. Roy. Soc.*, 1921, **99**, [*A*], 336—351).—A modification of the technique for examining the properties of thin films of substances on water is described, special attention being directed to the avoidance of leaks past the confining barriers and to correcting for the residual contamination on the water, which cannot be entirely avoided. The experiments on palmitic acid confirm, in general, Langmuir's results (A., 1917, ii, 525). The curves of compressibility of the films are accurately straight lines, except for a possible doubtful deviation at very low compressions. The properties of the film change abruptly at a hydrogen-ion concentration of $10^{-5}N$. The change is confined to films under compression less than about 16 dynes/sq. cm. The area occupied by each molecule becomes about 20% greater than on neutral solutions. Langmuir's view that the films consist of a single layer of molecules, orientated with their carboxyl groups toward the water, is confirmed and extended. Probably the hydrocarbon chains are tightly packed on neutral solutions, adjacent molecules being drawn into the water to different depths. On neutral solutions, the molecules rise in the water so that the carboxyl groups, which are probably of greater cross section than the chains, are in contact with each other. This arrangement gives a liquid film, whereas the packed hydrocarbon

chain normally gives a solid one. There is independent evidence of an increased attraction of water for carboxyl groups with increasing alkalinity. The formation of ionic micellæ of soap, as the film dissolves in the more alkaline liquids, is a simple consequence of the increased attraction on the carboxyl groups and the attractions of the chains for one another. Hysteresis in the unimolecular films of palmitic acid is absent, or extremely small in amount, at room temperature. Palmitic acid is completely insoluble in water, slightly on the acid side, of strict neutrality, and the films preserve their area and properties unchanged for hours. Compression beyond a certain point causes the films to collapse, the ejected molecules forming aggregates visible to the naked eye. The remainder of the film appears to be unchanged in properties. Different films and even different parts of the same film, vary very much in their resistance to collapse. The collapse appears to be aided by nuclei the nature of which can, at present, only be conjectured. J. F. S.

Viscosity and Molecular Dimensions of Gaseous Cyanogen. A. O. Rankine (*Proc. Roy. Soc.*, 1920, **99**, [*A*], 331—336).—The viscosity of gaseous cyanogen has been determined with the object of obtaining the data necessary to test the validity of the molecular structure of this gas put forward by Lewis (A., 1916, ii, 310) and Langmuir (A., 1919, ii, 328), and also of testing the hypothesis put forward by the author with reference to the collisions of non-spherical gaseous molecules (this vol., ii, 192). The viscosity was measured with highly purified material by the method previously described (A., 1910, ii, 829). The experiments yield the results $\eta_{15^\circ}=0{\cdot}986\times10^{-4}$ C.G.S. units and $\eta_{100^\circ}=1{\cdot}264\times10^{-4}$ C.G.S. units, from which, assuming the validity of Sutherland's law for the variation of viscosity with temperature, the value of the Sutherland constant C is calculated to 280 and $\eta_0=0{\cdot}935\times10^{-4}$ C.G.S. This agrees remarkably with Graham's value of $0{\cdot}95\times10^{-4}$ obtained by transpiration experiments. Making use of the values of C and η_0 and using Chapman's formula (*Phil. Trans.*, 1916, **216**, 279), the mean area presented by the cyanogen molecule in the gaseous state in collisions is $\bar{A}=1{\cdot}31\times10^{-15}$ cm.^{2}, a value which is probably accurate to 2%. Making the assumptions of Lewis and Langmuir with regard to the similarity of the nitrogen and cyanogen molecules, the distance apart of the centres is calculated to $2d=2{\cdot}30\times10^{-8}$ cm., that is, the diameter of the outer electron shell of the cyanogen molecule is $2{\cdot}30\times10^{-8}$ cm., which is remarkably close to the diameter of the outer electron shell of bromine, which, according to Bragg, has the value $2{\cdot}35\times10^{-8}$ cm., an agreement which is demanded by the fact that potassium bromide and cyanide have nearly the same molecular volume. J. F. S.

New Stalagmometer or Guttameter. Friedrich Eschbaum (*Ber. Deut. pharm. Ges.*, 1921, **31**, 211—219).—In the estimation of the surface tension of liquids by the drop method it is essential that the velocity of outflow should not exceed fourteen to sixteen drops per minute; this has been generally secured by attaching to

the stalagmometer or guttameter a sufficient length of capillary glass tubing. The same effect can be more readily obtained by the following device. The instrument is provided at its upper end with a glass stopcock which only has a hole on one side. The barrel is provided with grooves which run parallel to its length and communicate with one another at the top and bottom; a portion of the surface remains smooth in order that the stopcock may be closed. By suitably turning the stopcock, the air in its passage to the top of the liquid can be caused to pass through any desired length of capillary and the rate of outflow of the liquid can be thereby accurately regulated.

A table is given for the calculation of guttameter estimations to stalagmometer measurements and for the correction of the reading of any guttameter to normal guttameter weights. For every increase of 1° in the atmospheric temperature the weight of the drop (guttameter) decreases by 0·25% and the number of drops (stalagmometer) increases by 0·25%. H. W.

The Sorption of Hydrogen by Amorphous Palladium. JAMES BRIERLEY FIRTH (T., 1921, **119**, 1120—1126).

The Sorption of Alcohol and Water by Animal Charcoal. JOHN DRIVER and JAMES BRIERLEY FIRTH (T., 1921, **119**, 1126—1131).

Adsorption by Powdered Metals. I. HANS VON EULER and ARVID HJ. HEDELIUS (*Arkiv Kem. Min. Geol.*, 1920, **7**, No. 31, 1—15).—By reducing silver chloride by means of zinc and water and subsequently eliminating the zinc from the precipitated silver, the authors have obtained quite pure silver in a very finely divided form. By shaking such silver with dilute silver nitrate or potassium chloride solutions of various concentrations and titrating the solutions before and after this treatment, the proportion of the dissolved salt adsorbed by the powdered metal is ascertained.

In the case of silver nitrate, the acidity of the solution remains unaltered, so that the ion NO_3' is adsorbed as well as the silver ion; this result is in moderately good agreement with the results of conductivity measurements of the solutions before and after the adsorption. The finely divided silver settles more rapidly in presence of silver nitrate than in pure water. During the adsorption of potassium chloride no alteration takes place in the acidity of the solution, but in this case the silver collects into aggregates similar to those of silver chloride.

Calculation of the number of silver ions adsorbed per gram of the powdered silver and of the surface presented by the metal and comparison of the result with the values derived by other investigators for the radius of the sphere of molecular action afford strong support for the supposition that the adsorbed ions form several molecular layers or a molecular space as suggested by Polānyi.

Attempts to employ the powdered silver in sedimentation experiments in silver nitrate solution resulted unsatisfactorily, presumably

owing to the lack of uniformity in the magnitude of the metallic particles. T. H. P.

Adsorption of Water by Powdery Substances. K. Scheringa (*Pharm. Weekblad*, 1921, **58**, 937—942).—To determine the adsorption of water at different vapour tensions by various substances, they were enclosed in a U-tube, of which the interior was coated with paraffin and closed by perforated corks. A current of air was then passed through sulphuric acid and drawn through the tube, and by this means any desired degree of humidity was obtained. Animal charcoal has a high adsorption even at low vapour pressures; no surface condensation takes place with 30% humidity. Salts such as potassium bromide, chlorate, and sulphate effect no appreciable adsorption in moderately dry air; no surface condensation is found below 60% humidity. Powdered marble or quartz are very slightly adsorbent in very moist air; on the other hand, sand has a high adsorption, and is therefore unsuitable for estimation of water in foodstuffs. W. J. W.

Adsorption and Solubility. G. Georgievics (*Kolloid Zeitsch.*, 1921, **28**, 253—254).—A criticism of a paper, under the same title, by Lundelius (A., 1920, ii, 358) in which the author directs attention to some previous work on the relationship between adsorption and the other properties of the solvent and the dissolved substance (A., 1912, ii, 236; 1913, ii, 561). Several other points on which the work of the author is at variance with that of Lundelius are mentioned and criticised. J. F. S.

Diffusion Velocity in Solid Gold–Silver Mixed Crystals and the Diffusion Coefficient of Gold in Silver at 870°. W. Fraenkel and H. Houben (*Zeitsch. anorg. Chem.*, 1921, **116**, 1—15).—For measuring the diffusion velocity of gold into silver, use was made of Tammann's discovery of limiting concentrations in mixed crystals. It was found that gold–silver mixed crystals containing up to 6·0 mol.-% of gold, when in contact with pure gold, were turned deep black in half an hour by ammonium sulphide solution; mixed crystals containing from 6·0 to 12·0 mol.-% of gold were, under the same conditions, turned bluish-black, whilst crystals richer in gold were not attacked at all by the reagent. The diffusion experiments were made by embedding a silver wire vertically in a block of gold and heating at 870° for varying periods. The rate of diffusion of the gold into the silver wire was observed by etching the cross sectional surface of the silver wire with ammonium sulphide and observing the rate of decrease of diameter of the two zones corresponding with 0—6 to 6—12 mol.-% of gold. Applying the diffusion law to the results obtained, the diffusion coefficient at 870° was found to be 0·000037 $cm.^2$/per day. E. H. R.

Correlation of Compound Formation, Ionisation, and Solubility in Solutions. Outline of a Modified Ionisation Theory. James Kendall (*Proc. Nat. Acad. Sci.*, 1921, **7**, 56—62).—A theoretical paper in which the experimental results obtained

by the author and his colleagues are correlated and critically discussed (see Kendall and Booge, A., 1918, ii, 37; Gibbons and Kendall, A., 1915, i, 80). It is shown that the hypotheses of Milner, Ghosh, and others fail to explain the anomaly of the ionisation of strong electrolytes because they, like the older hypotheses, ignore the rôle of the solvent in ionisation. Working with non-aqueous solvents, it is observed that the most significant factor of conducting solutions is that they are non-ideal. Two non-associated substances which are chemically inert one towards the other never give a conducting solution on mixing. Ionisation is consequently always accompanied by interactions between the solvent and dissolved substance. In systems of one variable radicle, for example, dimethylpyrone and acids of widely divergent character, it is shown that the extent and stability of the compound formation, as determined from freezing-point curves, increase as the ionisation tendency or electro-affinity of the variable radicle, X, of the acid HX became more negative. In systems of more than one variable radicle, for example, aldehydes of divergent character with various acids, it is shown that the compound formation is more extensive the more electro-positive the radicle, R, of the aldehyde R·CHO and the more electro-negative the radicle, X, of the acid HX. In systems of the type ester–acid the extent of the compound formation increased regularly as the radicles R and R′ of the ester RCO_2R' were more electro-positive or as the radicle X of the acid HX was more electro-negative. In systems of the type acid–acid the weaker acid HX functions as a base with regard to the stronger acid HY, the stability of the resultant salt being greater the greater the electro-affinity of the radicles X and Y. From these results and conductivity measurements of the various mixtures it is shown that compound formation and ionisation proceed in parallel. Where compound formation is slight, ionisation is inappreciable, as compound formation increases in extent and where compound formation is very marked ionisation is extensive. Applying these results to aqueous solutions shows that the same facts are true. Strong acids invariably give stable hydrates whilst in no single case of a weak acid is there any indication of hydrate formation.

On the basis of the foregoing, the author puts forward a modified ionisation hypothesis, on the assumption that ionisation is preceded by compound formation and is indeed a consequence of such combination. According to this view, ionisation in solutions is due to neither the solvent nor the dissolved substance alone, but to a combination between the two to form unstable complexes. It has been shown that whilst in simple molecules the two radicles are in general attracted to each other so strongly that no dissociation is observable, yet in complex additive compounds the attractive forces between the radicles are so diminished that disintegration of the complex into oppositely charged ions may readily occur. Union with another molecule promotes ionisation. As evidence in favour of this view the case of the mercuric salts is quoted: all highly ionised mercuric salts yield hydrates [for example,

$Hg(NO_3)_2,8H_2O$; $Hg(ClO_4)_2,6H_2O$; $HgF_2,2H_2O$] whilst all slightly ionised salts are non-hydrated.

The solubility of salts is also shown to run parallel with compound formation. The sulphates of sodium and potassium are exceedingly soluble in pure sulphuric acid, those of barium, calcium, and magnesium are decreasingly soluble, and those of nickel, iron, and copper are practically insoluble. With electro-negative metals the solubility becomes appreciable with mercury and extensive with silver. The solubilities of formates in formic acid follow exactly the same rule. Similarly, the solubility of hydroxides in water (ROH—HOH) follow the same rule. J. F. S.

An Arrangement of a Microscope for the Examination of Opaque Crystals. M. François and Ch. Lormand (*Bull. Soc. chim.*, 1921, [iv], **29**, 366—374).—The arrangement consists of an ordinary microscope to the lower part of the objectives of which a small concave mirror, pierced with a hole, is fixed. A very small electric lamp with an S-filament is placed in the axis of the microscope, its light being rendered parallel by a small lens. The crystals to be examined are placed on a cover-slip, which in its turn is placed on an opaque disk on a microscope slide. W. G.

Law of Constant Proportions and Crystalline Structure according to W. H. and W. L. Bragg. E. Perucca (*Gazzetta*, 1921, **51**, i, 255).—Quartaroli's reasoning (A., 1920, ii, 602) is based on the presumption that the most simple crystalline individual must be composed of a complete elementary cell, as figured by Quartaroli or by Bragg and Bragg. Such elementary cell, however, serves only to establish how the various atoms of the molecules are arranged and orientated in the crystal during its formation, and is not intended to represent a crystalline individual actually existing. The latter is constituted of a whole number of molecules in accordance with the law of constant proportions and with the sole condition that the atoms constituting these molecules show suitable mutual orientation and constitute at least one elementary crystalline group in the sense indicated by Bragg and Bragg. T. H. P.

Dendritic Crystallisation and its Influence on the Strength of Metallic Alloys. Rudolf Vogel (*Zeitsch. anorg. Chem.*, 1921, **116**, 21—41).—A theoretical paper in which it is shown that the formation of dendritic crystals depends on the vectorial character of crystallisation velocity and on the rate of flow of heat from different parts of the surface of a polyhedral nuclear crystal in a crystallising system. When the rate of cooling, and consequently the velocity of crystallisation, is high, growth is inhibited at the crystal face but accelerated at the edges and corners, and dendritic forms result. The parts played in dendritic crystal formation by velocity and direction of cooling, heat of crystallisation, convection currents, heat conductivity, viscosity, and diffusion velocity are discussed. From the method of formation of dendritic crystals,

it follows that all the branches of a dendritic crystal have the same crystallographic orientation. This can be proved by etching tests on the surface of sections of alloys cut perpendicularly through a dendritic system. The extent of a unigranular dendritic system, for instance, in copper, cannot always be detected by etching. By subjecting the specimen to pressure, however, glide planes are revealed which establish the true boundaries of each unigranular dendrite. It is found in this way that the copper crystals are much larger than is indicated by the etching test. Since a dendritic system behaves as a single large crystal, it is to be expected that alloys crystallised in this way should have poor mechanical strength, as is actually the case. The improvement of mechanical strength by recrystallisation or working is due to the breaking up of the dendritic system, and the formation of much smaller, differently orientated crystals. E. H. R.

The Composition of Eutectics and the Limiting Members of Mixed Crystal Series. G. TAMMANN (*Zeitsch. anorg. Chem.*, 1921, **116**, 206—208).—A criticism of a paper by Daeves (this vol., ii, 454) in which it was shown that the composition of eutectics and saturated mixed crystals can be expressed in molecular fractions which are frequently multiples of 1/8. These proportions cannot have any relation to the distribution of the constituent atoms in space lattices, as suggested by Daeves. E. H. R.

Photo-sensitiveness of Arsenic Trisulphide Sols. H. FREUNDLICH and A. NATHANSOHN (*Kolloid Zeitsch.*, 1920, **28**, 258—262).—It is shown that sols of arsenic trisulphide are photochemically active. They sensitise the oxidation of colour substances, such as eosin and malachite-green, in light. The formation of colloidal sulphur by illuminating arsenic trisulphide sols depends on this photochemical sensitisation, for the hydrogen sulphide which is set free by the hydrolysis of the arsenic trisulphide is oxidised to sulphur through the sensitising action of the trisulphide micellæ. Mixtures of arsenic sulphide sols and sulphur sols are, according to Odén, unstable, although both are negatively charged. Both sols are amicroscopic, but on mixing under an ultra-microscope it is seen that the micellæ speedily become much larger. Consequently, the mixture of the sols is more sensitive to electrolytes than the individual sols; the coagulation values of hydrochloric acid and aluminium nitrate are less than half that for pure arsenic sulphide sol and still smaller than that for pure sulphur sols. This instability depends probably on a mutual action of the sols on one another, since the arsenic sulphide sol contains in all probability hydrogen sulphide or a polysulphide as active electrolyte, whilst the colloidal sulphur contains pentathionic acid. Pentathionic acid and hydrogen sulphide in the presence of one another are unstable and react with the formation of sulphur. The reaction robs the micellæ of both sols of their active electrolytes and reduces the stability. The arsenic sulphide sol is more sensitive to electrolytes after illumination because colloidal sulphur is formed in it, and colloidal sulphur which contains arsenic sulphide sol after

illumination exhibits a smaller coagulation value toward electrolytes, even in the dark. J. F. S.

Velocity of Coagulation of Hydrosols of Congo-rubin in the Presence of Carbamide and Sucrose. JOSEF REITSTÖTTER (*Kolloid Zeitsch.*, 1921, **28**, 268—269).—The velocity of coagulation of congo-rubin sols, which have been rendered more viscous by the addition of various stated amounts of carbamide or sucrose, has been determined. The method consists in adding to 1 c.c. of a congo-rubin sol (9–*a*) c.c. of distilled water, *a* c.c. of a solution of either carbamide or sucrose of known concentration, and after keeping for sixty seconds adding 1 c.c. of 2*N*-sodium chloride and noting the time required for the colour to change to a definite violet tint. The experiments show that for small increases in viscosity the velocity of coagulation decreases more rapidly than is to be expected from the increase in viscosity, intermediate increases in the viscosity give coagulation velocities approximately in keeping with the theory, whilst large increases in viscosity give a velocity of coagulation much greater than that demanded by the theory. When a coagulated blue congo-rubin sol containing carbamide, as above, is heated at 60°, it becomes red and on cooling to 18° and adding a further quantity of 1 c.c. of 2*N*-sodium chloride it again coagulates, but much more rapidly than before. A further repetition of the process gives a still more rapid coagulation. The original solution before warming required fifty secs. for coagulation, after once warming thirty-two secs. were necessary and after twice warming twenty-two secs. J. F. S.

The Equilibria of Permutites. F. W. HISSCHEMÖLLER (*Rec. trav. chim.*, 1921, **40**, 394—432).—An examination of the transformations of a sodium permutite with ammonium chloride indicates the production of false equilibria (chemical hysteresis), which can be removed by repeated transformations at the ordinary temperature. The position of the real line of equilibrium is displaced by repeated transformations with warm solutions. By keeping the permutite for some time in the dry state, the positions of both the false and true equilibria change, and the hysteresis diminishes but does not disappear. With such a permutite that has been kept for some time, a single transformation with ammonium chloride results in the almost complete disappearance of the hysteresis. The position of the false and true equilibria is independent of the dilution and the size of the particles in the transformation sodium permutite $\rightleftharpoons$ ammonium permutite. An industrial permutite behaved like a laboratory preparation which had been kept for some time.

The transformation sodium permutite $\rightleftharpoons$ calcium permutite also showed hysteresis, which was not suppressed by a single transformation. The final states depend on the dilution, but agree only qualitatively with the formula of Rothmund and Kornfeld (A., 1918, ii, 315).

The last part of the paper contains a critical survey of other

work on this subject, and an explanation of the hysteresis is given based on the structure of mixed crystals. W. G.

Some Base Equilibria in Permutite. A. GÜNTHER-SCHULZE (*Zeitsch. anorg. Chem.*, 1921, **116**, 16—20).—Experiments on basic exchange in permutite were made by shaking a known weight of pure sodium, potassium, or ammonium permutite with measured volumes of solutions of different salts of known concentration, and subsequently, by analysis of the final solution, determining how much of the positive ion of the salt had been taken up by the permutite. The salts employed included those of copper, magnesium, zinc, nickel, cobalt, aluminium, barium, strontium, calcium, thallium, silver, manganese, chromium, lead, rubidium, and uranyl. Since the reaction is ionic, comparison should be made only between those bases the permutites of which have dissociation constants or conductivities of the same order. According to conductivity, the permutites fall into three groups, those of the alkali metals, silver, and thallium, $50—90 \times 10^{-5}$, those of the alkaline earth metals, $9—11 \times 10^{-5}$, and the rest with very slight conductivities. In general, the equilibrium constants obtained from the above experiments fall into similar groups, with certain exceptions. Silver and thallium, in spite of the strong dissociation of their permutites, are almost entirely removed from solution, whilst nickel and cobalt remain in solution. Generally the higher the atomic weight of the metal, the more readily it is removed from solution by the permutite, but aluminium is an exception to this rule. E. H. R.

The Decomposition of Acid Salts of Dibasic Acids in Aqueous Solution, especially the Influence of Bases on the Amount of this Decomposition. TH. SABALITSCHKA and H. SCHRADER (*Zeitsch. anorg. Chem.*, 1921, **116**, 183—192. Compare A., 1920, i, 707).—If the decomposition of acid salts of dibasic acids into neutral salt and free acid, or, in other words, the partition of the base between the two acid groups, is governed only by the ratio of the two dissociation constants, it should be independent of the base. Experiments to test this point were made by dialysing aqueous solutions of sodium, ammonium, and aniline hydrogen sulphates, and determining the free acid in the diffusate. The amounts of free acid found in the diffusate were in the proportion 0·58 : 0·23 : 1·5 for the sodium, ammonium, and aniline salt respectively. The high value of the aniline salt can be accounted for by hydrolysis, but the difference between the sodium and ammonium salts can only be due to the influence of the base on the decomposition of the acid salt. Experiments in which aqueous solutions of the potassium and ammonium salts of succinic and α-camphoric acid were extracted with ether also showed that the amount of free acid present in such solutions was not independent of the base. E. H. R.

Chemico-kinetic Study of the Velocity of Reaction. M. PADOA (*Gazzetta*, 1921, **51**, i, 193—200).—The author has investigated

the course of the combination of chlorine with hydrogen in presence of traces of iodine, under the influence of white, green, blue, or violet light, and at 0°, 10°, 20°, 30°, and 40°. The results obtained confirm the variability of the temperature coefficient of the reaction with the wave-length of the light used (compare A., 1915, ii, 678, 719; 1916, ii, 508, 592). Further, with variation of the temperature from 0° to 40°, the velocity of the reaction increases continuously with white or green light, whereas with violet or blue light it is greater at 20° than at either 0° or 40°. The existence of such a maximum in the velocity of reaction has not previously been observed, although diminution of the velocity of reaction with rise of temperature occurs with the interaction of iodate and iodide (Skrabal and Weberitsch, A., 1914, ii, 187), with the decolorisation of triphenylfulgide in yellow light (A., 1916, ii, 508), and with the oxidation of nitric oxide (Wourtzel, A., 1920, ii, 173).

The present condition of the kinetic theory of the velocity of reaction is discussed, particularly as regards the developments introduced by Pratolongo (A., 1918, ii, 70) and by Stern and Volmer (A., 1920, ii, 461) and the explanations they suggest of the fall in the reaction velocity with rise of temperature.

T. H. P.

The Velocity of Reaction in Mixed Solvents. I. The Velocity of Saponification of Two Ethyl Esters in Ethyl Alcohol–Water Mixtures. ALBERT ERIC CASHMORE, HAMILTON McCOMBIE, and HAROLD ARCHIBALD SCARBOROUGH (T., 1921, **119**, 970—978).

Velocity of Hydrolysis of *p*-Nitrophenetole. A. V. BLOM (*Helv. Chim. Acta*, 1921, 4, 510—516).—The experiments described form a continuation of the author's work on the production of ethers from chloronitrobenzene and alkyl oxide (this vol., i, 413). Hydrolysis was effected by means of the calculated amount of potassium hydroxide in aqueous alcoholic solution at 70° and at the boiling point of the solution. The conditions with regard to concentration are chosen in such a manner that they are strictly comparable with those of the previous series. The course of the reaction is followed by the titration of aliquot portions of the mixture at definite intervals with $0{\cdot}1N$-nitric acid, congo- and phenolphthalein-paper being used as indicator (K_0- and Ph-titre). After two hundred hours about 60% of the ether is hydrolysed at 70°, about 40% at the boiling point of the solution. The percentage of nitrophenol present in the mixture at any instant can be calculated from the formula $4{\cdot}3[K_0-(Ph+2)]=\%$ nitrophenol. The gradual fall in the K_0 titre is due to the reduction of the nitrophenetole to the corresponding azoxy-derivative by the alkyl oxide and the percentage of azoxy-compound can be calculated from the formula $2{\cdot}87(23{\cdot}3-K_0)=\%$ azoxy. The constants of the reaction for the interval thirty to two hundred hours at 70° are nitrophenol $k_2=0{\cdot}43\times10^{-4}$ and azoxy-compound, $k_2=0{\cdot}014\times10^{-4}$ at 70° and for the interval twenty to one hundred and fifty hours are $k_2=1{\cdot}15\times10^{-4}$ for the nitrophenol

and $k_2=0{\cdot}10\times10^{-4}$ for the azoxy-derivative at the boiling point of the solution. H. W.

Measurements of the Maximal Stability of Organic Compounds. I. HANS VON EULER and INGVAR LAURIN (*Arkiv Kem. Min. Geol.*, 1920, **7**, No. 30, 1—16).—Dilute aqueous solutions of ethyl acetate have been examined in order to ascertain the acidities for which the ester is most stable at given temperatures. The inactivation constant for saccharase (A., 1920, i, 506), k_C, is compared with the hydrolysis constant of the ester, k, at the maximal stability, the velocity constant of the hydrolysis at 69·3° and $p_H=5{\cdot}1$ being taken as 4×10^{-6}. For saccharase ($p_H=4{\cdot}5$), $k_C=6{\cdot}6\times10^{-3}$, whilst for ethyl acetate (p_H=about 5), k=about 2×10^{-6}. The temperature at which saccharase, under these acidity conditions, is inactivated to the extent of one-half, is 59·3°, whilst the corresponding temperature for the hydrolysis of ethyl acetate is 150—200°. Hence, the stability of ethyl acetate in aqueous solution is of a far higher order of magnitude than that of saccharase, and the conclusion is drawn that the inactivation of saccharase is a different process from the hydrolysis of an ester.

The temperature coefficient of the inactivation of saccharase indicates a pronounced maximum of the stability for an acidity of about $p_H=4{\cdot}5$ (*loc. cit.*). At the optimal stability, ethyl acetate is so stable that for $p_H=4{\cdot}5$ the temperature coefficient of the hydrolysis cannot be determined, but when $p_H=3{\cdot}3$, this coefficient between 80° and 90° only slightly exceeds the value at $p_H=1$.

T. H. P.

Variations in the Catalytic Power of Electrosols of Platinum. A. DE GREGORIO ROCASOLANO (*Compt. rend.*, 1921, **173**, 41—43. Compare A., 1920, ii, 607).—Even in very short intervals of time the catalytic power of electrosols of platinum varies, the variations being much more intense in the non-stabilised than in the stabilised colloids. These variations in the catalytic power of the systems are attributed to incessant variations in the composition (concentration of oxygen) of the disperse particles, and the stabiliser acts in restraining this constant transformation. From certain electrical measurements, the author concludes that the electric charge of the colloidal system is not the seat of its catalytic power. W. G.

New Conceptions of Electrolytes. II. The Introduction of a Catalysis Coefficient in Hydrogen-ion Catalysis. ERLING SCHREINER (*Zeitsch. anorg. Chem.*, 1921, **116**, 102—116).—In catalytic reactions such as the hydrolysis of esters or the inversion of sucrose by acids, assuming complete dissociation and that only the hydrogen ions are active, the reaction velocity should be proportional to the concentration. Actually, however, the catalytic effect at higher concentrations is greater, and a similar accelerating effect is produced by the addition of neutral salts. It is shown that, by the introduction of a catalysis coefficient, f_k, this extra catalytic effect can be accounted for. The new coefficient is found to be the reciprocal of the conductivity–viscosity coefficient, f_μ, which

is the ordinary conductivity coefficient corrected for the viscosity of the electrolyte (compare this vol., ii, 425). The ratio v/C, where v is the reaction velocity and C the acid concentration, thus corrected to vf_{μ}/C, gives a very good constant in the hydrolysis of acetates by hydrochloric acid alone and in presence of neutral salts, in the inversion of sucrose, and in the keto $\rightarrow$ enol acetone transformation. The degree of dissociation of weaker acids, such as dichloroacetic or cyanoacetic acid, can be calculated from catalysis measurements, and the results agree very closely with those calculated from conductivity measurements. E. H. R.

Catalytic Decomposition of Hydrogen Peroxide. GÖSTA PHRAGMÉN (*Med. K. Vetenskapsakad. Nobel-Inst.*, 1919, **5**, No. 22, 1—13; from *Chem. Zentr.*, 1921, iii, 86—87).—The catalytic decomposition of alkaline, catalase-free hydrogen peroxide solutions was studied, varying the hydrogen-ion concentration by means of phosphoric acid and sodium hydroxide. The velocity of decomposition showed a slight maximum at P_H 11·8. The strongly alkaline, phosphate-free solution gave varying results even under identical conditions of experiment. The velocity of decomposition decreased both with increase and decrease of hydrogen-ion concentration, probably owing to the fact that the salt formed from hydrogen peroxide and sodium hydroxide is fairly stable and that only the free hydrogen peroxide takes part in the reaction. The velocity of reaction is not, however, purely a function of the hydrogen-peroxide concentration. A change was noted from a high rate of decomposition at P_H 9·9 to a negligible decomposition at P_H 8·6. The reaction is probably influenced by the presence of phosphate ions. Greater reaction velocities were obtained using ammonia and ammonium chloride solutions as buffer mixtures than in the case of the alkaline phosphate mixtures. The decomposition is almost completely inhibited by a potassium cyanide concentration of 0·0001, which may be attributed to a direct effect on the catalyst. G. W. R.

Velocity of Decomposition and Catalysis of Sodium Perborate. UMBERTO SBORGI and GIULIO NOCENTINI (*Gazzetta*, 1921, **51**, i, 289—307).—The authors have investigated the decomposition of sodium perborate in aqueous solution at various temperatures and find that at 10°, 20°, and especially 40° this decomposition does not follow any simple law, although it corresponds approximately with a unimolecular reaction; the values of K lie, however, on a regular curve which passes through a maximum. The decomposition products of the perborate influence the reaction, boric acid and sodium hydroxide having a retarding effect, which is due to mass action, and the metaborate a slight accelerating effect, which is more strictly catalytic. On the decomposition of the hydrogen peroxide originating by hydrolysis of the perborate, the above decomposition products as a whole exert an accelerating influence. The velocity of the decomposition at 20° is about double that at 10°, and that at 40° five to six times that at 20°. Tannin has no, and acetanilide but little, action on the decomposi-

tion, although both these compounds retard the decomposition of hydrogen peroxide considerably. Platinum, gold, and copper sheet, wire, or granules, and especially platinum-black, greatly accelerate the decomposition, and iron, nickel, and zinc retard it slightly, whilst some metals are without effect. Salts of iron, copper, lead, mercury and cobalt, sodium carbonate, etc., hasten the decomposition, which becomes almost instantaneous in presence of manganous sulphate; zinc, tin, and nickel salts act in the opposite way, cadmium salts cause enormous retardation, and aluminium, magnesium, and chromium salts are virtually without effect. As a rule, the catalytic effect of a salt is proportional to its concentration, but that of nickel sulphate passes through a maximum at a certain concentration. T. H. P.

Mutual Reaction of Oxalic Acid and Iodic Acid. II. Influence of Different Catalysts. GEORGES LEMOINE (*Compt. rend.*, 1921, **173**, 7—13. Compare this vol., ii, 108).—Platinum-black, spongy platinum, and charcoal from different sources were the catalysts examined, and of these platinum-black was by far the most active. In every case, the catalyst was relatively most effective at low temperatures and the effect increased with the weight of catalyst used and its fineness of division, but in neither case proportionately. The effect of gases previously occluded by the catalyst was examined, but no definite differences were established. W. G.

The Catalytic Oxidation of Alcohols under the Influence of Photoactive Ketones and the Explanation of the Phenomena of Catalysis. J. BÖESEKEN (*Rec. trav. chim.*, 1921, **40**, 433—445. Compare A., 1916, ii, 464; A., 1920, ii, 744).—Certain fresh experimental data in conjunction with previous work (*loc. cit.*, and Cohen, A., 1919, i, 124, 210; 1920, i, 393) are quoted as decisive proof of the theory of dislocation of catalysis, and based on it is given an explanation of the fundamentals of all catalytic phenomena. W. G.

Report of the Swiss Commission on Atomic Weights. A. L. BERNOULLI, P. DUTOIT, PH. A. GUYE, and W. D. TREADWELL (*Helv. Chim. Acta*, 1921, **4**, 449—458).—Owing to the peculiar position of Switzerland, the necessity for the consideration of a separate table of atomic weights arises from the fact that complete agreement does not exist between the data given by the International Committee of the American, British, and French Chemical Societies, and by the German Chemical Society. The main discrepancies occur in the cases of argon, nitrogen, boron, columbium, gallium, scandium, thorium, and yttrium. For the present, it is proposed to adopt those values for atomic weights which have not been revised by the International Committee since the 1916 report. In case where the figures have since been revised, they are only adopted in the following circumstances: (1) if the new and old values differ by 1/1000 to 1/10000 they must be obtained in a concordant manner by at least two different methods,

and (2) if differing by 1/1000 to 1/100 they must be derived as the concordant result of at least three different methods. H. W.

An Extraordinary Numerical Relationship between Calcium and Strontium. ALEXANDER SAKOSCHANSKY (*Chem. News*, 1921, **123**, 20).—If 0·11063 ($\log_{10}$ 1·290) be used as a multiplicand for atomic weights, it will give several pairs of corresponding values. J. R. P.

The Constitution of Molecular Compounds. PAUL PFEIFFER (*Zeitsch. angew. Chem.*, 1921, **34**, 350—354).—The aid afforded by the principles of isomorphism and substitution in studying the structure of molecular compounds, especially those in the labile form, is considered. The former principle is exemplified in a study of the constitution of complex platinum compounds (double chlorides, etc.), and the latter, in that of the neutral salts of amino-acids, and the quinhydrones. W. J. W.

Derivation of Acid Formulæ from a Law of Homopolar Atom Combination. HEINRICH REMY (*Zeitsch. anorg. Chem.*, 1921, **116**, 255—266).—The theory of Kossel (A., 1916, ii, 243), in which the formation of heteropolar combinations of atoms is accounted for in terms of the distribution of electrons in the valence spheres, does not account satisfactorily for homopolar compounds, in particular for the formation of acids from acid anhydrides. Sulphuric anhydride, for example, should be a completely saturated molecule. The hypothesis is now advanced that in such compounds the electrons which bring about the combination by transference, for example, from the sulphur to the oxygen atom, are not completely detached from the parent atom. The general tendency of every atom to surround itself with a group of eight electrons in its valence sphere again comes into play; six partly-detached electrons are already present, and there is therefore a tendency to combine with another oxygen atom to form the ion SO_4''. It is shown that in all co-ordinative saturated oxygen acids (ortho-acids) derived from elements in the five groups preceding the rare gases in the periodic system the central atom has the electron number 8, with the exception of the acids from boron, carbon, nitrogen, and aluminium, in which the central atom is surrounded by only six electrons. E. H. R.

Electrochemical Conceptions of Valency. JOHN ALBERT NEWTON FRIEND (T., 1921, **119**, 1040—1047).

New Forms of Soxhlet Extraction Apparatus. F. SIMION (*Chem. Zeit.*, 1921, **45**, 592).—One form of apparatus described is similar to an ordinary Soxhlet extractor, but the siphon is replaced by a U-shaped trap which delivers the condensed solvent back again into the extraction flask; the extraction thimble is supported in the cylindrical part of the apparatus; a tapped tube on one of the arms of the U-shaped trap allows portions of the solvent to be drawn off from time to time for examination. Another extractor consists of a wide tube having at its lower end a fairly wide stem,

the extraction thimble being supported in the wide tube. The vapours of the solvent rise through the stem, pass round the thimble, and up into the reflux apparatus, whilst the condenser solvent from the latter falls into the thimble and returns through the stem to the extraction flask.

OSKAR HAGEN (*ibid.*) discusses the advantages and disadvantages of these two pieces of apparatus. W. P. S.

Inorganic Chemistry.

The Reaction between Halogen Cyanides and Sodium Thiosulphate. ALBIN KURTENACKER (*Zeitsch. anorg. Chem.*, 1921, **116**, 243—249).—From the work of Meineke (A., 1893, ii, 246) and Dixon and Taylor (T., 1913, **103**, 974), it would appear that cyanogen bromide and iodide react differently with sodium thiosulphate. It is now shown, however, that there is no such difference. In neutral solution, the reaction may be represented by the equation $3CNBr+5S_2O_3''+H_2O=3Br'+2HCN+CNS'+SO_4''+2S_4O_6''$. In acid solution, the thiosulphate goes entirely into tetrathionate according to the equation $BrCN+2S_2O_3''+H^{\cdot}=Br'+HCN+S_4O_6''$. This is probably also the primary reaction in neutral solution, for during the reaction the solution becomes temporarily alkaline through the formation of sodium cyanide. The latter, however, reacts with tetrathionate according to the equation $3NaCN+Na_2S_4O_6+H_2O=NaCNS+Na_2SO_4+2HCN+Na_2S_2O_3$. The thiosulphate thus regenerated reacts further with halogen cyanide, and the net reaction is that represented by the first equation given above. E. H. R.

The Action of Cyanide on Tetrathionate. ALBIN KURTENACKER and ALBERT FRITSCH (*Zeitsch. anorg. Chem.*, 1921, **117**, 202—208).—Kurtenacker has shown (preceding abstract) that the tetrathionate produced in the reaction between halogen cyanide and sodium thiosulphate reacts with the sodium cyanide formed at the same time according to the following equation: $Na_2S_4O_6+3NaCN+H_2O=NaCNS+Na_2SO_4+Na_2S_2O_3+2HCN$. According to Gutman, however (A., 1906, i, 149), when the reaction is carried out in hot alkaline solution the products are thiocyanate, sulphate, and sulphite, whilst Mackenzie and Marshall (T., 1908, **93**, 1726) state that the same products are formed in the cold in absence of alkali. Further study of the reaction has now shown that it always proceeds primarily according to the above equation, with formation of thiosulphate. In presence of excess of cyanide, the thiosulphate can react further, with formation of sulphite and thiocyanate. This reaction, however, does not take place in dilute solution at the ordinary temperature, and only slowly and incompletely at

the boiling point. It only becomes quantitative in concentrated solution after long heating. On the formation of thiosulphate by the action of cyanide on tetrathionate is based an analytical method for determining the latter. To the neutral solution of the tetrathionate is added excess of potassium cyanide, the solution is acidified and the thiosulphate formed is titrated with iodine. One molecule of thiosulphate corresponds with one of tetrathionate.

E. H. R.

The Preparation of Selenic Acid. JULIUS MEYER and HANNS MOLDENHAUER (*Zeitsch. anorg. Chem.*, 1921, **116**, 193—200).—Selenic acid is reduced by hot hydrochloric acid to selenious acid with liberation of chlorine, but nevertheless chlorine can be used to oxidise selenious to selenic acid if the hydrochloric acid is removed as soon as it is formed. This was accomplished by passing a current of chlorine through a cold solution of selenious acid in concentrated nitric acid containing lead nitrate. The selenic acid formed separated as lead selenate, whilst the hydrochloric acid produced was reoxidised to chlorine. A more convenient and efficient method for the preparation of large quantities of selenic acid was based on the observation that selenium or selenious acid is oxidised completely to selenic acid by chloric acid. Selenium is first oxidised to selenious acid by heating with nitric acid. Rather more than the theoretical quantity of chloric acid, prepared from barium chlorate and sulphuric acid, avoiding excess of the latter, is added gradually, and the solution heated to expel chlorine and chlorine oxides. By concentrating in a vacuum, perchloric acid is removed, and a concentrated solution containing 85—90% of selenic acid is obtained, the yield being about 90—95% of the theoretical. By heating above 160°, selenic acid is slowly decomposed into oxygen and selenious acid.

E. H. R.

Researches on Residual Affinity and Co-ordination. VI. Selenodithionic Acid and its Metallic Salts. GILBERT T. MORGAN and J. D. MAIN SMITH (T., 1921, **119**, 1066—1070).

The Rôle of Gaseous Impurities in the Catalytic Oxidation of Ammonia. EUGÈNE DECARRIÈRE (*Compt. rend.*, 1921, **172**, 1663—1666).—Small amounts of hydrogen, 0·44% by volume of the gaseous mixture, increase the activity of platinum as a catalyst in the oxidation of ammonia, whilst larger amounts, 1·0—1·5%, slightly lower the yield. The presence of hydrogen sulphide causes a progressive but not an absolute lessening of the activity of the catalyst.

W. G.

Ammoniates as Binary Systems. I. FRITZ FRIEDRICHS (*Zeitsch. anorg. Chem.*, 1921, **116**, 141—160).—The three dimensional pressure–temperature–concentration curves for binary systems are discussed in detail for the following cases: (1) the components do not form a compound; (2) a compound is formed, (*a*) with a stable, (*b*) with a meta-stable melting point; (3) mixed crystals are formed, (*a*) in an unbroken series, (*b*) with a miscibility gap; (4) two liquid phases are formed. From a consideration of isothermal sections of

the three dimensional diagrams, which are pressure-concentration curves, it is shown that solubility relations can conveniently be investigated by measuring the equilibrium pressure at a comparatively small number of concentrations, when these are suitably chosen. An apparatus is described, designed to apply this tensimetric method to the investigation of ammonia systems at low temperatures down to $-50°$. E. H. R.

The Absorption of Oxides of Nitrogen by Nitric and Sulphuric Acids. A. SANFOURCHE (*Compt. rend.*, 1921, **172**, 1573—1576).—When nitric oxide and nitrogen peroxide, mixed in equimolecular proportions, act on sulphuric acid they do not behave like a simple mixture of the two gases, although this for the most part is what the gaseous mixture consists of. Although the proportion of nitrogen trioxide is small, its velocity of action is such that it serves as an intermediary in the solution, being reformed as fast as it is absorbed. This mechanism applies, not only to the absorption by sulphuric acid, but also to that by nitric acid, water, and alkalis. The two actions are (1) $NO+NO_2=N_2O_3$, (2) $N_2O_3+2H_2SO_4=2NO\cdot SO_4H+H_2O$. W. G.

The Distillation of Nitric Acids and of Mixtures of Sulphuric and Nitric Acids. PAUL PASCAL [with M. GARNIER] (*Ann. Chim.*, 1921, [ix], **15**, 253—290).—A more detailed account of work already published (A., 1917, ii, 569; 1920, ii, 162, 752). W. G.

Stability Relations of the Glass and Crystal Phases of Silicon Dioxide. RUDOLF WIETZEL (*Zeitsch. anorg. Chem.*, 1921, **116**, 71—95).—The heats of crystallisation of quartz, cristobalite, and chalcedony were determined by measuring their heats of solution and that of quartz glass in hydrofluoric acid and subtracting the former from the latter. Quartz and chalcedony gave the same value, about 2·2 cal. per mol., whilst that of cristobalite was lower, about 0·6 cal. per mol. The mean specific heats of these substances were also determined between normal temperature and their melting points. At high and low temperatures, quartz glass has the greatest specific heat, as it should have, being the modification stable at the higher temperature, but over a wide range it has a lower specific heat than quartz and cristobalite, and below 575° cristobalite has a lower specific heat than quartz. Variations in the transition temperatures and in the corresponding heats of transformation in the case of quartz and cristobalite were found to depend on the state of division of the material. With very finely-divided quartz the transition point was scarcely to be detected. It is concluded that chalcedony is not a distinct form of silica, but microcrystalline quartz. The melting point of cristobalite was found to be 1696°. Quartz can be melted without conversion into cristobalite; its melting point is between 1600° and 1670°.

To construct the energy ($A-U$) diagrams for the different phases of silica, by application of Nernst's heat law, the specific heats

of quartz, cristobalite, and quartz glass were determined at very low temperatures, down to about 18° abs. The calculated *A–U* diagram for the cristobalite–quartz transition agreed completely with the observations, the meta-stable transition point being at 1400°. E. H. R.

Some Unsaturated Silicon Compounds. HANS KAUTSKY (*Zeitsch. anorg. Chem.*, 1921, **117**, 209—242).—The unstable substance first obtained by Wöhler by the action of cold hydrochloric acid on calcium silicide has been further investigated. Two compounds of different stages of oxidation, between calcium silicide and silica, have been isolated. By carefully treating the silicide with cold dilute alcoholic hydrochloric acid in the dark, a white, solid substance was obtained, its formation being accompanied by evolution of hydrogen. It is spontaneously inflammable in air. Its composition corresponds with the formula Si_2H_2O, and its properties indicate the constitution $Si_2H{\cdot}OH$. It has been called *oxydisilin.* It is a powerful reducing agent, and can be oxidised quantitatively by means of bromine to silical bromide, Si_2OHBr, the term *silical* being used to signify the radicle Si_2OH—. Silical bromide is hydrolysed by water to form *silical hydroxide,* a red compound, which combines with strong acids, such as hydrochloric, sulphuric, formic, or acetic, to form salts which are all yellow to red in colour. The silical compounds are all powerful reducing agents. They, as well as oxydisilin, are decomposed by alkalis with evolution of hydrogen and formation of silica.

Halogenated hydrocarbons such as carbon tetrachloride, chloroform, or ethyl iodide in presence of traces of water and under the influence of light oxidise oxydisilin to silical compounds. The reaction does not proceed in the dark, but is extremely sensitive to light.

It is remarkable that oxydisilin and the silical compounds prepared as described above retain the external crystalline form of the calcium silicide from which they are formed, and the same crystalline form persists when oxidation is carried to the final stage, silica. That the substances have a very open structure is shown by the rapidity with which reactions proceed in the solid state, and also by the marked absorption of basic dyes by the end-product, silica. Rapid oxidation of the silical compounds, for example, by permanganate, is accompanied by the phenomenon of chemi-luminescence in a remarkable degree.

The unsaturated character of these compounds cannot yet be satisfactorily accounted for. The silical compounds may be of the oxonium salt type, and a certain similarity to some compounds of bivalent germanium suggests that the silicon in these compounds may be bivalent.

Silicalamino-compounds are formed by the action of anhydrous ammonia on the silical compounds, and from these, by the action of alcohols, liquid and solid organosilicon compounds are formed. These compounds belong to a higher stage of oxidation than the silical compounds. E. H. R.

Sodium Perborate. F. Foerster (*Zeitsch. angew. Chem.*, 1921, **34**, 354—355).—The composition of sodium perborate is more correctly represented by $NaBO_2,H_2O_2,3H_2O$ than by $NaBO_3,4H_2O$. When the salt, after dehydration at 50—55°, is further heated at 120° in a vacuum, it loses water, and the residue, which evolves oxygen on treating with water, consists chiefly of $(NaBO_2)_2O_2$ with some $NaBO_2,H_2O$ and metaborate. This compound, $(NaBO_2)_2O_2$, has properties which differ from those of $NaBO_3$, and this tends to imply the existence of a substitution product of hydrogen peroxide of the composition $ONa{\cdot}B{<}\genfrac{}{}{0pt}{}{O}{O}\!\!|$, analogous to persulphates and percarbonates. This is confirmed by the fact that sodium perborate has been electrolytically prepared (Arndt., A., 1916, ii, 429). Sodium perborate, obtained by the action of hydrogen peroxide on the metaborate, behaves as the salt of an acid of greater strength than boric acid. W. J. W.

Colour of the Photochlorides and Colloidal Silver. I. Karl Schaum and Hermann Lang (*Kolloid Zeitsch.*, 1921, **28**, 243—249).—The authors have prepared silver sols of different colours and examined the effect of the size of the particles and the distance between the particles on the optical behaviour of the sols. The colours of the photochlorides have been compared with those of the silver sols, and the silver haloid has been removed from the photo-haloid and the properties of the remaining silver examined. The silver sols are prepared from a nucleus sol in gelatin solutions to which is added definite quantities of a solution, *B*, consisting of 2 grams of sodium thiosulphate and 2 grams of *p*-phenylenediamine in 100 c.c. of water, and a definite quantity of a solution, *A*, consisting of 18 grams of sodium thiosulphate and 0·75 gram of silver nitrate in 100 c.c. of water, which is added very slowly. The nucleus sol is made from 10 c.c. of 10% yellow dextrin, 10 c.c. of 10% sodium hydroxide solution, 7·5 c.c. of 10% silver nitrate solution, and 22·5 c.c. of water, after keeping for thirty minutes, diluted to 1500 c.c. The preparation of the various sols is represented thus; the colours being for transmitted light.

	Colour.	Nucleus sol.	1% Gelatin.	Sol. *A*.	Sol. *B*.
I	orange-red	0·2 c.c.	9·2 c.c.	0·4 c.c.	0·2 c.c.
II	deep-red	5 c.c. of Sol. I	4·5 c.c.	0·2 c.c.	0·1 c.c.
III	deep reddish-orange	5 c.c. of Sol. II	4·5 c.c.	0·2 c.c.	0·1 c.c.
IV	dark red	5 c.c. of Sol. III	4·5 c.c.	0·2 c.c.	0·1 c.c.
V	purple	5 c.c. of Sol. IV	4·5 c.c.	0·2 c.c.	0·1 c.c.
VI	bluish-violet	5 c.c. of Sol. V	4·5 c.c.	0·2 c.c.	0·1 c.c.
VII	bluish-green	5 c.c. of Sol. VI	4·5 c.c.	0·2 c.c.	0·1 c.c.

The various sols become somewhat lighter in colour on dilution, and display the following colours by reflected light, I, practically colourless, II, blue, III, greyish-blue, IV, bluish-green—grey, V, greyish-green, VI, greyish-yellow, and VII, yellow. Treatment of the sols with reagents which dissolve silver such as photographic reducers and hydrogen peroxide does not cause the sols of small dispersity to pass through the above-named colour changes in the

reverse direction. Measurements of the diameter of the particles show that for transmitted colours the following diameters are associated with the following colours: yellowish-orange, $60\mu\mu$; orange-red, $90\mu\mu$; purple, $120\mu\mu$; violet, $150\mu\mu$, and bluish-green, $180\mu\mu$. J. F. S.

The Binary System, Ag_2S–Tl_2S. HANS HUBER (*Zeitsch. anorg. Chem.*, 1921, **116**, 139—140).—Equilibrium conditions in the silver sulphide–thallium sulphide system were investigated by the thermal method. The eutectic point is at 306° with 55% Tl_2S. When less than 31% of thallium sulphide is present, an arrest point is found at 358°, due to a reaction between the separated silver sulphide and the liquid phase, resulting in the formation of a crystalline compound, $4Ag_2S,Tl_2S$. Confirmation of the thermal data was obtained from the microscopical structure of the different mixtures. E. H. R.

Ammoniacal Silver Carbonate. DERVIN and OLMER (*Compt. rend.*, 1921, **172**, 1662—1663).—By repeated spontaneous evaporation in air of ammoniacal solutions of silver oxide, it was possible to obtain, after filtering off a small amount of metallic silver, crystals of ammoniacal silver carbonate, $Ag_2CO_3,4NH_3,H_2O$. Exposed to the air, these crystals lose water and ammonia, giving silver carbonate, which retains the shape of the original crystals. The ammoniacal carbonate blackens in sunlight. W. G.

The Solubility of Calcium Sulphide in Presence of Hydrogen Sulphide. E. H. RIESENFELD and H. FELD (*Zeitsch. anorg. Chem.*, 1921, **116**, 213—227).—The solubility of calcium sulphide in water is increased in presence of hydrogen sulphide, through the formation of calcium hydrosulphide. At 20°, the solubility of commercial calcium sulphide in water was found to be 0·212 gram per litre. Determinations were made of the solubility in presence of hydrogen sulphide at 0°, 20°, and 40° under pressures of the gas from 40 mm. to 760 mm. At 20° and 760 mm., the solubility, calculated as CaS, is 206·5 grams per litre. At pressures above about 200 mm., the relation between solubility and partial pressure of hydrogen sulphide can be expressed by a linear equation of the form $c=K_1+K_2p$ for each temperature, the values of K_1 and K_2 being, at 0°, 28·65 and 0·00499; at 20°, 25·17 and 0·00696, and at 40°, 23·10 and 0·00708. Over the whole range, the empirical equation $c=\sqrt{K_3\log p}$ expresses the results with fair accuracy. Pure calcium sulphide can be prepared by extracting the crude material with aqueous hydrogen sulphide under pressure, in absence of air to avoid formation of polysulphide, and precipitating the pure calcium sulphide by removing the hydrogen sulphide from the solution at low pressure. E. H. R.

Colloidal Arsenates. II. Cadmium Arsenate Jellies. G. KLEMP and J. VON GYULAY (*Kolloid Zeitsch.*, 1921, **28**, 262—268. Compare A., 1915, ii, 256; 1918, ii, 200).—When solutions of dihydrogen potassium arsenate are added to solutions of cadmium

sulphate of appropriate concentrations, firm, transparent jellies are produced which cannot be poured from the vessel in which they are prepared. The same result is obtained when normal sodium arsenate which has been rendered neutral by the addition of acetic, hydrochloric, or arsenic acid is employed in place of the above-named salt. The jellies are not very stable, and on keeping for a short time become opalescent, whereon crystallisation sets in and the jelly becomes liquid. The crystals are very small and quite insoluble in water, as is also the gel, but both are readily soluble in dilute hydrochloric acid. The composition of the gel could not be determined because of its great instability. The crystalline salt has the composition $2Cd_3(AsO_4)_2,4CdHAsO_4,9H_2O$, and is to be regarded as a molecular mixture of tertiary and secondary arsenates. J. F. S.

A Hitherto Unknown Copper Aluminate of the Spinel Type. J. Arvid Hedvall and Josef Heuberger (*Zeitsch. anorg. Chem.*, 1921, **116**, 137—138).—When cupric oxide and aluminium oxide are heated together, a reaction starts at about 700° and proceeds quickly between 750° and 850°. The product, which forms a chocolate coloured powder, has, when freed from unchanged oxides, the composition CuO,Al_2O_3, and is therefore of the spinel type. It is very resistant to solvents in general. When fused with potassium chloride, it undergoes partial decomposition, and the undecomposed portion crystallises on cooling in well-formed cubes and octahedra. E. H. R.

Ternary Aluminium Alloys. M. Waehlert (*Metall u. Erz*, 1921, **18**, 298—307).—The effect on the physical properties of aluminium of additions up to 10% of each of the following metals, copper, zinc, tin, and iron, was first investigated and the results were illustrated graphically. Copper and zinc increase the hardness and tensile strength but reduce the ductility, whilst tin has very little effect. The hardness, tensile strength, and elastic limit have been determined of the aluminium-rich ternary alloys with copper–zinc, copper–tin, and iron–zinc. The alloys of the first two series show a much smaller volume change on solidification than pure aluminium, and are in general harder and tougher but less ductile than the pure metal. Iron has a bad effect on zinc–aluminium alloys; it renders them hard, brittle, and difficult to pour (compare *J. Soc. Chem. Ind.*, 1921, 547A). A. R. P.

Reduction of Inorganic Haloids. I. Reduction with Aluminium and [the Preparation of] Aluminium-triarsenic Trichloride. Otto Ruff and Karl Staib (*Zeitsch. anorg. Chem.*, 1921, **117**, 191—201).—The catalytic action of aluminium chloride for inorganic reactions has been previously pointed out by Ruff (A., 1901, ii, 500; 1902, ii, 13). Arsenic trichloride can be reduced with yellow phosphorus in presence of aluminium chloride, forming a red compound sparingly soluble in arsenic trichloride. The same compound can be obtained in a purer form by heating together at 135—140° aluminium powder and arsenic trichloride with a

little aluminium chloride as catalyst. In absence of the catalyst, the reaction does not take place at all. The reaction takes place according to the equation $3AsCl_3+3Al=AlAs_3Cl_3+2AlCl_3$. Excess of aluminium chloride can be removed by extracting the product with hot arsenic trichloride, and after removal of the solvent by heating, the composition of the product agrees with the formula $AlAs_3Cl_3$. The oxidation equivalent, determined by treating the compound with concentrated sulphuric acid and titrating the sulphurous acid formed with iodine, was found to be 5, from which it follows that the compound contains only three principal valencies. The arsenic must therefore be regarded as held by co-ordination valencies. This view is supported by the fact that water decomposes the compound into aluminium chloride and black arsenic. Titanium tetrachloride and ammonia also decompose the compound, black arsenic being formed. It is stable in dry air, and when heated above 170° decomposes with formation of aluminium arsenide, arsenic, and arsenic trichloride thus: $AlAs_3Cl_3=AlAs+As+AsCl_3$. It is shown that aluminium arsenide and arsenic trichloride are also formed when black arsenic is heated with aluminium chloride at 120°. The new compound has d^{22} 2·85.

E. H. R.

Tervalent Manganese. JULIUS MEYER and ROBERT NERLICH (*Zeitsch. anorg. Chem.*, 1921, **116**, 117—136. Compare Meyer, A., 1913, ii, 599).—Experiments on the autoxidation of manganous compounds have led to the general conclusion that manganous hydroxide in suspension or in colloidal solution is oxidised by atmospheric air directly to manganese dioxide, whilst complex manganous salts in ammoniacal or alkaline solution are oxidised to manganic hydroxide. Manganous ions are not oxidised at all by atmospheric oxygen. The experiments were conducted by measuring the volume of oxygen absorbed by the manganous compound under specified conditions, and the results were confirmed by analysis of the products. Acceptors such as sodium sulphite or arsenite had no influence on the velocity or course of the reaction. Manganous hydroxide precipitated by sodium, potassium, calcium, or barium hydroxide gave in each case manganese dioxide, but a solution of manganous hydroxide in excess of ammonia in presence of ammonium chloride gave a precipitate of manganic hydroxide of a characteristic yellowish-brown colour. Potassium and sodium manganocyanides were oxidised to manganic hydroxide, whilst solutions of a manganous salt mixed with potassium thiocyanate were not oxidised at all.

In presence of tartaric or oxalic acid, manganous salts are not precipitated by alkalis, and autoxidation takes place rapidly. In presence of ammonia, the product is manganic hydroxide, but in presence of sodium or potassium hydroxide, manganese dioxide is formed, probably because in presence of these stronger alkalis the complex compound is less stable, some manganous hydroxide being always present and oxidising directly to the dioxide.

The oxidation by means of air of a solution of manganous chloride

made alkaline with ammonia, in presence of ammonium chloride, affords the most convenient method for preparing manganic hydroxide. The product is identical except in colour with that prepared by hydrolysis of potassium manganicyanide with water (*loc. cit.*), the darker colour of the latter being due to contamination with decomposition products of the cyanide. It is shown that acid hydrolysis of manganic salts leads to the formation of manganese dioxide and manganous salt, whilst alkaline hydrolysis merely precipitates manganic hydroxide. By acid hydrolysis, however, probably manganic hydroxide is first formed and at once decomposed, since it is shown that manganic hydroxide is decomposed by dilute mineral acids into manganese dioxide and manganous salt. That manganic hydroxide is a true tervalent manganese compound is probable from the fact that dilute hydrofluoric acid, hydrocyanic acid, and oxalic acid dissolve it completely, to form complex mangani-compounds. Concentrated sulphuric, selenic, phosphoric, hydrochloric, and hydrofluoric acids also dissolve it completely, but concentrated nitric acid oxidises it completely to manganese dioxide. Small traces of manganese can be detected by oxidising an ammoniacal solution of the mangano-salt with air, filtering, and treating the filter paper with a few drops of concentrated orthophosphoric acid. A reddish-violet colour is characteristic of manganese. This test is not interfered with by the presence of copper, ferrous and ferric iron, or cobalt. E. H. R.

Ultramicroscopic Investigation of Manganous Arsenate Jellies. FR. FLADE, H. SCHERFFIG, and E. DEISS (*Zeitsch. anorg. Chem.*, 1921, **116**, 228—230).—The observations of Deiss (A., 1914, ii, 371) on the formation and properties of manganous arsenate jellies and their gradual crystallisation have been confirmed. Glycerol retards the crystallisation to some extent. Reproductions of ultra-photomicrographs show the fibrous structure of the jellies and the change of structure which accompanies ageing.

E. H. R.

The Retarded Solution and Premature Precipitation of Iron Carbide in Steels and the Influence of the Initial State on these Phenomena. A. PORTEVIN and P. CHEVENARD (*Compt. rend.*, 1921, **172**, 1490—1493).—A study of a differential curve of dilatation of an eutectic steel shows a period of marked dilatation with heating consecutive to the transformation *Ac*. This anomaly has been interpreted as a manifestation of the retardation of solution of the cementite and shows a smaller amplitude as the temperature is increased less rapidly. Similarly, when the homogeneity of the solid solution is not realised, there is observed during cooling and a little before the commencement of the transformation *Ar* a region of marked dilatation. The steel appears to be hypereutectoid, or, in other words, there is premature precipitation of the cementite. This is confirmed by a comparison of the two curves for the same steel obtained in one case when the steel was coalesced, the metal having been previously annealed in such a way as to contain the

cementite in the globular state, whilst in the second case the steel was regenerated by several heatings followed by rapid cooling, resulting in a perlitic structure. The premature precipitation is manifest in the first case, but does not appear in the second.

W. G.

The Reaction between Ferrous Oxide and Carbon and between Carbon Monoxide and Iron. IV. V. FALCKE (*Zeitsch. Elektrochem.*, 1921, **27**, 268—278. Compare A., 1913, ii, 327; 1915, ii, 169; 1916, ii, 484).—The author's own earlier work and that of Schenck and others (A., 1905, ii, 519; 1907, ii, 470) is reviewed and criticised. In a recent paper (A., 1918, ii, 355), Schenck throws doubt on the author's observation that ferrous oxide can be reduced by graphite at temperatures at which pure amorphous carbon is inactive. Fresh experiments have now shown that both ferrous and ferric oxide can be reduced completely by mixing with rather more than the theoretically necessary amount of graphite, compressing into tablets and heating at 900—1000° whilst the gases evolved are pumped away. The product obtained was not pure iron mixed with excess of graphite, as was previously obtained, but contained combined carbon.

To test further Schenck's theory that free carbon is an active constituent of the solid phase of the reaction between ferrous oxide and graphite and between carbon monoxide and iron, fresh determinations of the equilibrium constant were made for these two reactions and for the reaction $C+CO_2 \rightleftharpoons 2CO$ at temperatures between 600° and 750°, the equilibrium for the last reaction being measured in presence of metallic nickel. The values of the equilibrium constants did not correspond, and it is concluded that elementary carbon plays no part in the equilibrium of the two reactions above. The earlier conclusion that carbides are formed and determine the equilibrium explains best the experimental results.

E. H. R.

Microscopic Forms of Iron Rust. ADOLF ACKERMANN (*Kolloid Zeitsch.*, 1921, **28**, 270—281).—The rusting of small particles of iron, spongy iron, and iron wire in a moist atmosphere and in an atmosphere containing acid vapours, has been observed under a microscope. The forms assumed by the rust have been reproduced in drawings and photographs. It is shown that forms taken up by the rust depend in the first place on the formation of ferric hydroxide. This colloidal substance assumes forms and passes through formation processes which are very like the forms and processes which occur in organised nature. Non-rigid threads are formed which grow like organic fibres and which move and change their form when subjected to changes in the external conditions, for example, temperature. Under certain conditions, cell formation is exhibited, which externally, at least, is similar to organic cell formation. Drops of a solution of ferric hydroxide possess properties which are otherwise only found in organic cells. They exhibit a solid or semi-solid enclosing semi-permeable membrane or cell-wall, an adhering colloidal layer, and a nucleus.

Such drops grow, become broader, and divide in exactly the same manner as is observed in the division of organised cells. J. F. S.

Action of Sodium Carbonate on Solutions of Chrome Alum. L. MEUNIER and P. CASTE (*Compt. rend.*, 1921, **172**, 1488—1490).—The amount of sodium carbonate necessary to produce a permanent precipitate in a solution of chrome alum varies with the age and method of preparation of the solution. Immediately after the solution has been prepared, there is a relatively short period during which the amount of sodium carbonate required increases with the time up to a maximum which varies with the dilution and the temperature. This period is longer and more marked the more concentrated is the solution and the lower the temperature. After this maximum, there is a relatively long second period, which may last several months, during which the amount of sodium carbonate required decreases slowly with the time. At high temperatures, and particularly at 100°, the two periods are of such short duration that the end of their combined action is almost immediate.

Immediately on its dissolution in water, chromium sulphate undergoes a partial hydrolysis resulting in a provisional equilibrium. The chromium hydroxide and chromium sulphate interact to give a less ionised complex more stable towards sodium carbonate. This process predominates at first. This immediate hydrolysis progresses and is slowly accentuated (compare Tian, this vol., ii, 439, 440) and the ionic concentration is increased until the second process gradually predominates, with the consequent requirement of less sodium carbonate for the precipitation of the chromium hydroxide. W. G.

Tungsten-Nickel Alloys. RUDOLF VOGEL (*Zeitsch. anorg. Chem.*, 1921, **116**, 231—242).—Tungsten-nickel alloys containing from 0—80% of tungsten were prepared and examined thermally and microscopically. With the alloys richer in nickel, the accurate observation of the temperatures of the thermal effects, both of crystallisation and transition in the solid state, is rendered difficult owing to supercooling, which is liable to occur. Alloys containing more than 50% of tungsten lose their fluidity and become more pasty with increasing tungsten content at the highest temperature which could be employed for their preparation, 1600°. For alloys containing 0—35% of tungsten, the crystallising temperature rises from 1475° to 1525°, whilst a second, very irregular thermal effect is observed below 900°, becoming steady at 905° with 35% of tungsten. The maximum crystallisation point at 1525° corresponds with the composition Ni_6W. From 35% of tungsten the crystallisation curve falls to 1510° at 47% of tungsten, this being the limiting composition for complete miscibility. There is a eutectic point at 52% of tungsten, 1510°, the eutectic consisting of saturated mixed crystals of Ni_6W and tungsten with pure tungsten. The secondary thermal effect which, in alloys containing from 45% of tungsten upwards, is constant at 905°, appears to be due to the separation of saturated mixed crystals into their

constituents Ni_6W and tungsten. The limiting composition for ferromagnetism at the ordinary temperature in the alloys is between 10% and 20% of tungsten. The separation of the mixed crystals into their constituents at 905° is probably due to the transformation of the nickel from the β- to the α-form. E. H. R.

Titanium Hydride. ALBERT KLAUBER (*Zeitsch. anorg. Chem.*, 1921, **117**, 243—248).—The existence of a hydride of titanium has been proved by the method employed by Paneth and Nörring (A., 1920, ii, 758) for establishing the existence of a hydride of lead. When the gases from the titanium electrode were passed through a heated hard-glass tube (as in the Marsh test for arsenic), a deep black, highly metallic mirror appeared, shading off into greyish-black in the immediate vicinity of the flame, and on the other side through violet to reddish-brown. The best results were obtained with 0·1 to 0·2*N*-sulphuric acid as the electrolyte at 40—45°, using as cathode a hard-glass tube filled with gypsum and tipped with titanium. The identity of the titanium deposit in the heated tube was established by a number of microchemical tests. The gaseous hydride of titanium is odourless and tasteless. It is condensed at the temperature of liquid air, and can be revaporised by allowing the temperature to rise. Dilute solutions of sodium and potassium hydroxide, sodium carbonate, and silver nitrate absorb the gas. E. H. R.

The Crystalline Structure of Antimony and Bismuth. A. OGG (*Phil. Mag.*, 1921, [vi], **42**, 163—166).—The conclusion of James and Tunstall (A., 1920, ii, 548) is confirmed, that the unit rhomb contains eight atoms in the case of both antimony and bismuth. The edge of the unit antimony rhomb is 6·20 Å.U., the structure consisting of two interpenetrating face-centred lattices. The shortest distance between the centres of two atoms is 2·92 Å.U. The length of the edge of the bismuth rhomb is 6·52 Å.U. The spacing of the planes differs somewhat from that of James and Tunstall. J. R. P.

The Crystalline Structure of Bismuth. R. W. JAMES (*Phil. Mag.*, 1921, [vi], **42**, 193—196).—The unit rhomb contains eight atoms. The length of the edge of the unit rhomb is 3·28 Å.U. The distance of closest approach between two atomic centres is 3·11 Å.U. J. R. P.

The Action of Sodium Hyposulphite on Metallic Salts of the Platinum Group. GÉZA SAILER (*Zeitsch. anorg. Chem.*, 1921, **116**, 209—212).—When sodium platinichloride is reduced with sodium hyposulphite in excess, a dark, reddish-brown solution is obtained which, on slow evaporation, deposits a reddish-brown precipitate, consisting of a mixture of complex sodium platinosulphite compounds with $Na_2Pt_4S_6$. Later reddish-brown crystals of $Na_4[Pt''''(SO_3)_3(OH)_2]H_2O$ separate. When these are filtered off and the solution is further evaporated, bright yellow crystals of *sodium platinothiosulphate*, $Na_6[Pt''(S_2O_3)_4],10H_2O$, are obtained.

The complex sulphite compounds are precipitated from the reduced solution by alkalis, neutral salts such as potassium chloride, or by large excess of hyposulphite. When the reduction is carried out in acid solution, the acid decomposition products of the above reduction products are obtained. Alkaline reduction of palladium salts appeared to give only palladium sulphide. By neutral reduction of iridium chloride, $IrCl_4$, *sodium iridosulphite*, $Na_6[Ir''(SO_3)_4],10H_2O$, was obtained in bright yellow crystals. A new *rhodium* compound, $Na_6[Rh''_4(SO_3)_7],12H_2O$, was obtained as a brownish-red precipitate by reduction of sodium rhodium sesquichloride, $Na_6Rh_2Cl_{12}$, in neutral or alkaline solution. A greenish-yellow solution of sodium osmichloride, Na_2OsCl_6, becomes reddish-brown on addition of sodium hyposulphite, and after prolonged boiling a dull violet precipitate forms, which is a new compound, $Na_6[Os''_4(SO_3)_7],24H_2O$. Ruthenium sesquichloride, Ru_2Cl_6, reduced in the warm, also gave a new compound, $Na_3H_3[Ru''(SO_3)_4]$. E. H. R.

Hexachlororuthenates [Ruthenichlorides]. F. KRAUSS (*Zeitsch. anorg. Chem.*, 1921, **117**, 111—120).—In a previous paper it was shown (Gutbier and Krauss, A., 1915, i, 120) that ruthenichlorides of organic ammonium compounds could be prepared by leading chlorine into a concentrated hydrochloric acid solution of the corresponding ruthenochlorides, but alkali ruthenichlorides have not yet been obtained, even in presence of excess of chlorine. *Cæsium ruthenichloride* has now been prepared by dissolving ruthenium tetroxide in hydrochloric acid at the ordinary temperature under reduced pressure, to obtain a solution containing 1·7% of ruthenium, and adding a 5% solution of cæsium chloride. The solutions are thus chosen to be as concentrated as possible, so that the ruthenichloride separates at once. After washing with warm hydrochloric acid and drying, it has the composition $Cs_2[RuCl_6],H_2O$, and forms small, reddish-brown crystals, easily soluble in warm dilute hydrochloric acid with a bright red colour which quickly changes to a very dark red. The ruthenium is completely precipitated from solution by hydrogen sulphide; no other ruthenium compounds behave in this manner. Attempts to prepare the corresponding rubidium and potassium salts gave products more or less contaminated with ruthenochloride. E. H. R.

Reduction of Osmic Acid by Fats. J. R. PARTINGTON and D. B. HUNTINGFORD (*J. Roy. Micr. Soc.*, 1921, i, 15—19; from *Physiol. Abstr.*, 1921, **6**, 238).—The black substance formed by the reduction of osmic acid (osmium tetroxide, OsO_4) by olein in tissue staining is a hydrated form of osmium dioxide (OsO_2), probably $OsO_2,5H_2O$. E. S.

Mineralogical Chemistry.

Presence of Zinc in Malachite from Chessy. C. Perrier (*Atti R. Accad. Lincei*, 1921, [v], **30**, i, 309—311).—It has been shown that rosasite, to which Lovisato attributed the formula $2CuO,3CuCO_3,5ZnCO_3$, is in reality a basic zinc–copper carbonate with the constitution $(Zn,Cu)CO_3,Cu(OH)_2$, which is analogous to that of malachite. Thus, rosasite resembles aurichalcite, in which also part of the zinc is replaced by copper. Analysis of a sample of pure, crystallised malachite from Chessy gives the results:

H_2O.	CO_2.	CuO.	ZnO.	Fe_2O_3.	PbO.	Residue.	Total.
8·36	19·87	71·31	0·45	0·04	trace	trace	100·03

In molecular proportions, these figures correspond with $1{\cdot}02H_2O : 1{\cdot}00CO_2 : 1{\cdot}99(CuO+ZnO)$, so that the sample represents a typical malachite in which a small, but appreciable, proportion of the copper is replaced by zinc. T. H. P.

Analytical Chemistry.

Gas-absorption Flask. Walz (*Chem. Zeit.*, 1921, **45**, 658).—A characteristic feature of a modified gas-absorption flask is a hollow stopper, prolonged as a closed tube with perforations in the end and extending to the base of the flask. The wide portion of the stopper fitting into the neck of the flask has a depression opposite the inlet tube, and an aperture opposite the outlet tube, of the flask. Gas drawn into the flask passes downwards through the absorbing substance into the base of the tubular part of the stopper and upwards to the aperture opposite the outlet. Apart from its simplicity and lightness, the apparatus offers the advantage of being readily emptied, and choking is prevented by rotating the stopper. W. J. W.

Poirrier's Blue C4B as an Indicator. W. Mestrezat (*J. Pharm. Chim.*, 1921, **23**, 489—494).—Poirrier's Blue C4B cannot be recommended for use as an indicator in acidimetry; the colour change at the end-point is not sharp, and is still less so when carbonates are present. W. P. S.

Determination of Hydrogen-ion Concentration by means of Indicator Papers. I. M. Kolthoff (*Pharm. Weekblad*, 1921, **58**, 961—970).—In determinations of the hydrogen-ion concentration in small quantities of solutions, indicator papers give results in close agreement with those obtained with indicator solutions, provided sufficient of a buffer mixture is used. The

papers should be prepared from hardened filter-paper. To ensure uniformity, the drop of the solution should be applied by means of a marked capillary, and the comparison of the colour with a standard should be made before the drop has dried. From an investigation of a number of indicator papers, the following values for p_H between which they are effective were obtained: congo-red, 2·5—4·0; methyl-orange, 2·6—4·0; blue lacmoid, 4·8—6·0; alizarin, 4·6—5·8; metachrome-red, 6·0—8·5; brilliant yellow 6·8—8·0; red litmus, 6·6—8·0; blue litmus, 6·0—7·8; azolitmin, 6·0—8·0; α-naphtholphthalein, 8·2—9·5; and curcumin, 7·5—9·5. Hæmatoxylin paper may be used for strong acids; methyl-red, phenolsulphonphthalein, rosolic acid, and neutral red have not proved suitable for determining p_H. W. J. W.

Iodometric Estimations by Stortenbeker's Method. D. DE MIRANDA and A. E. ROEST VAN LIMBURG (*Chem. Weekblad*, 1921, **18**, 419—420).—To determine the point at which chlorine ceases to be evolved in iodometric estimations by Stortenbeker's method (A., 1890, 1185), a side branch with a tap is fused into the delivery tube of the retort, and connected by means of a ground glass joint with a vessel containing iodide–starch solution. The gas is periodically tested with this solution, and the latter eventually returned to the retort, thus avoiding loss. W. J. W.

Estimation of Soil Acidity by means of the Iodine Method. O. LEMMERMANN and L. FRESENIUS (*J. Landw.*, 1921, **69**, 97—104). —The method based on the liberation of iodine from potassium iodide–iodate mixture by the soil acids (A., 1915, ii, 655) has several weak points. Iodine is adsorbed by the soil, thus lowering the apparent acidity figure; iodine may be liberated from the reagent by organic matter; and the time of contact of soil and reagent largely influences the result obtained. Iodine adsorption may be corrected for by a previous determination of the adsorption curve, and subsequent calculation for the particular conditions of the experiment. The liberation of iodine is incomplete after the fifteen minutes' contact suggested by Stutzer and Haupt, and better results are obtained with a contact period of two hours. The method is considered too complicated and uncertain to be of any great value. A. G. P.

Titration of Bases Combined with Weak Acids, and of Very Weak Bases with Acids, and Vice Versâ. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 885—896).—With tropæolin-OO or -O as indicator, acids and bases having a dissociation constant above 10^{-10} may be titrated with an accuracy of 1%. Acids may also be titrated when combined with bases, or vice versâ, with a dissociation constant equal to or less than 10^{-4}. W. J. W.

Detection and Estimation of Minute Quantities of Bromide in Saline Residues, and in a Mixture of the Halogens. A. J. JONES (*Pharm. J.*, 1921, **106**, 475—477).—To detect the presence of a bromide in a chloride or in a saline residue (this must be free from ammonium salts and organic matter), 5 c.c. of a 10% solution

of the sample are placed in a small distillation flask, 1 drop of dilute thymol-blue solution is added, followed by $N/1$-sulphuric acid in quantity just sufficient to give a rose-pink coloration; after the addition of 0·3 c.c. of permanganate solution (potassium permanganate 5 grams, phosphoric acid, d 1·75, 6·25 c.c., and water to 100 c.c.), the mixture is heated at 85° and a current of air is passed through it. The air and vapours are then conducted through a U-tube containing 5 c.c. of magenta reagent. With a quantity of bromine equivalent to 1·0 c.c. of $N/1000$-potassium bromide solution a distinct purple coloration develops in the U-tube. The coloration becomes more distinct when the contents of the U-tube are shaken with 7 c.c. of chloroform. The test may be rendered quantitative by comparing the coloration with those given by known amounts of bromine. If iodides are present, the iodine must be removed previously by treating the solution with sodium nitrite and phosphoric acid and shaking it with chloroform. The magenta reagent is prepared by adding 100 c.c. of a 0·1% magenta solution to a cold mixture of 60 c.c. of water and 40 c.c. of sulphuric acid; after twenty hours, the yellow solution is ready for use when mixed with its own volume of glacial acetic acid. W. P. S.

Argentometric Titration of Iodides. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 917—920).—In estimating iodides by titration with silver nitrate, a difficulty in determining the end-point is overcome by adding a colloid to hold the precipitated silver iodide in suspension. Starch solution used as indicator, if in sufficient amount, achieves this object. When 25 c.c. of $N/10$-iodide solution, 10 c.c. of 0·00008—0·0001N-iodine solution, and 20 c.c. of 2% starch solution are titrated with $N/10$-silver nitrate, the blue colour changes first to green and then to light green, and by adding excess of the reagent a colour change to yellow occurs which is readily detected. Bromide and chloride, not exceeding 3% and 20% respectively, do not influence the reaction. Either acid or neutral solutions may be used, and accurate results may be obtained even with low concentrations. No advantage is gained by using palladium salts as indicators as recommended by Schneider (A., 1918, ii, 205). W. J. W.

Estimation of Dissolved Oxygen in Water. REINALDO VANOSSI (*Anal. Asoc. Quím. Argentina*, 1921, **9**, 96—120).—A review of methods employed for the estimation of dissolved oxygen in water. The Winkler iodometric method is discussed in detail.
G. W. R.

Estimation of Sulphur in Oils. ENRIQUE HAUSER (*Anal. Fís. Quím.*, 1921, **19**, 175—191).—In the method described, the substance under examination is burnt in a closed vessel filled with oxygen, ignition being effected by means of an electric coil. After cooling and introduction of a dilute solution of sodium peroxide to oxidise sulphurous acid, the vessel is washed out and, after addition of a little bromine water to ensure complete oxidation, sulphur is estimated as sulphate in the united washings. The

method is considered generally applicable to the determination of sulphur in organic compounds. [See, further, *J. Soc. Chem. Ind.*, 1921, Aug.] G. W. R.

Estimation of Nitrogen in Nitrates by Arnd's Method. O. NOLTE (*Zeitsch. anal. Chem.*, 1921, **60**, 167—168).—The method described by Arnd (A., 1917, ii, 504) is trustworthy. W. P. S.

Estimation of Nitrates in Bismuth Salts by means of Titanium Chloride and Devarda's Alloy. THOS. MCLACHLAN (*Pharm. J.*, 1921, **106**, 477—478).—Reduction of the nitrate by titanium trichloride is best effected in approximately neutral solution, a slight excess of alkali being added subsequently, but previously to the distillation of the ammonia. A more convenient and trustworthy method for the estimation of nitrate in bismuth carbonate or other salt consists in mixing 5 grams of the sample with 150 c.c. of water, 5 c.c. of alcohol, and 50 c.c. of 33% potassium hydroxide solution, and adding 8 grams of Devarda's alloy; after ten minutes, the ammonia is distilled and titrated in the usual way. W. P. S.

The Estimation of Phosphoric Acid as Magnesium Pyrophosphate. VI. D. BALAREFF (*Zeitsch. anorg. Chem.*, 1921, **117**, 91—102. Compare A., 1919, ii, 426).—A critical review of previous work on the estimation of phosphoric acid or magnesium by precipitation as magnesium ammonium phosphate. Neubauer's method, or a single precipitation on the cold, is not to be recommended, as it gives accurate results only under special conditions. The double precipitation method gives good results only if the first precipitate is dissolved in not too little hydrochloric acid, if only Cl' and NO'_3 anions and no large quantity of alkali kations are present during precipitation, and the second precipitation is carried out by quick addition of 10% ammonia solution. Jörgensen's method (A., 1906, ii, 579; 1911, ii, 536) is inaccurate and Järviner's method (A., 1905, ii, 62, 555) gives low results. The only method which, under the right conditions, gives a pure product and an accurate result is that of Schmitz (A., 1919, ii, 426). This method is accurate under widely varying conditions, since the errors cancel one another. E. H. R.

Estimation of Small Quantities of Phosphate in Glycerophosphates. J. L. LIZIUS (*Pharm. J.*, 1921, **106**, 478—479).—One gram of the glycerophosphate is dissolved in dilute nitric acid, the solution is diluted to 50 c.c., and 10 c.c. of this solution are added to a mixture of 10 c.c. of 25% nitric acid and 10 c.c. of 10% ammonium molybdate solution; the yellow coloration obtained is compared with that produced by 5 c.c. of 0·004% phosphoric acid solution under the same conditions. If the colorations are of equal intensity, the sample contains 0·1% of inorganic phosphoric acid; should the colorations be different, the quantities of test solution or standard phosphoric acid solution used are varied accordingly. In the case of ferric glycerophosphate, the sample is dissolved in warm dilute nitric acid, sodium hydroxide is added,

the ferric hydroxide separated by filtration, and the filtrate diluted to 50 c.c. and used for the estimation. W. P. S.

Arsenic as a Normal Constituent of Soils. FEDERIGO REICHERT and ROGELIO A. TRELLES (*Anal. Asoc. Quím. Argentina*, 1921, **9**, 89—95).—In the estimation of arsenic in soils, the air-dried soil is heated with a mixture of sulphuric and nitric acids (1 : 2) on a sand-bath until nitric acid is eliminated. The residue is extracted with water. Arsenic is estimated in an aliquot portion of the filtrate after precipitation together with the hydroxides of iron and aluminium by means of aqueous ammonia. Examination of soils from various parts of the Argentine shows that arsenic is a constant constituent, but that it is not possible to correlate its amount with the chemical composition of the soil. Up to 2·25 mg. per 100 grams of soil were found. The amount of arsenic found is greater at the surface than in the lower strata of the soil (compare Zuccari, A., 1913, ii, 151—152; 1914, i, 128). G. W. R.

Volumetric Estimation of Arsenic Acid and Arsenates. R. LEITCH MORRIS (*Pharm. J.*, 1921, **106**, 486—488).—The method described in the British Pharmacopœia is untrustworthy owing to the fact that the mixing of the reagents alone causes a liberation of iodine; the solution must not be diluted before titration, or reversal of the reaction occurs, and a further error, but in the opposite direction, is due to the action of the relatively concentrated acid on the thiosulphate. If, however, the titration is commenced as soon as the arsenate solution has been mixed with the hydrochloric acid and iodide solution, the thiosulphate solution being introduced drop by drop with constant stirring, and the titration finished in five minutes, the error is fairly constant and may be corrected by deducting 0·0040 gram from the actual quantity of disodium hydrogen arsenate found by the titration. The presence of nitrates in any considerable quantity interferes with the estimation. W. P. S.

Estimation of Sodium Arsenate. C. E. CORFIELD and ELSIE WOODWARD (*Pharm. J.*, 1921, **106**, 473—475).—Comparison of various methods showed that the one described by Gooch and Morris (A., 1900, ii, 686) is trustworthy; this also applies to Williamson's method, provided that the calculation is made from the iodine titration. The method described in the British Pharmacopœia does not make allowance for the inaccuracy of the thiosulphate titration and, consequently, the error amounts to about 1%. W. P. S.

The Estimation of Total Carbon and a New Method of Estimating Graphitic Carbon in Ferrous Alloys. P. WENGER and A. TRAMPLER (*Helv. Chim. Acta*, 1921, **4**, 547—551).—Comparative examination of the methods of Corleis's, and of the electric, furnace method with iron containing 0·2—8·3% of impurities has led the authors to the conclusion that the results obtained by the latter method are more concordant among themselves than those given by Corleis's process, that the furnace method is much more rapid,

and is universally applicable, and, lastly, that it does not involve a preliminary treatment with chlorine, which invariably induces a small error in the estimation of carbon.

The use of phosphoric acid in the estimation of graphitic carbon has also been investigated. The method consists in heating the phosphoric acid (*d* 1·7) in a platinum capsule to at least 150° and gradually introducing the finely-divided alloy, 100 c.c. of acid being used for each gram of the latter. A small residue generally remains unattacked, and the original acid is therefore decanted and replaced by 25 c.c. of fresh acid. The mixture is filtered without dilution through a Gooch crucible, the residue washed with water (300 c.c.) and the carbon ultimately burnt in the electric furnace. The method is applicable to ferromanganese, ferro-vanadium, ferrochrome, and ferrosilicon. Certain alloys are, however, incompletely attacked, but the addition of sulphuric, hydrochloric, or nitric acid to the phosphoric acid is of no advantage. The presence of hydrofluoric acid enables the method to be applied satisfactorily to ferrosilicons containing not more than 60—65% of silicon. The addition of metallic catalysts, such as platinum or mercury, does not yield satisfactory results. H. W.

A New Method for Determining the Volatile Matter yielded by Coals up to Various Temperatures. WILLIAM ARTHUR BONE and LEONARD SILVER (T., 1921, **119**, 1145—1152).

Volumetric Estimation of Potassium. ST. MINOVICI and C. KOLLO (*Bul. Soc. Chim. România*, 1921, **3**, 17—25).—About 0·25 gram of the potassium salt is dissolved in 5 c.c. of water, 0·5 gram of sodium hydrogen tartrate is added, and the mixture is stirred occasionally during one hour. Five c.c. of 5% tartaric acid solution saturated with potassium hydrogen tartrate are then added; the precipitated potassium hydrogen tartrate is collected on a filter, washed with the tartaric acid solution (about 20 c.c.), then with 40 c.c. of alcohol, and, finally, with 50 c.c. of a mixture of equal volumes of alcohol and ether. The precipitate may be dried and weighed, or it may be dissolved and titrated in the usual way. W. P. S.

Detection and Estimation of Potassium as Picrate. ST. MINOVICI and AL. IONESCU (*Bul. Soc. Chim. România*, 1921, **3**, 25—33).—The reagent used is a saturated solution of picric acid in 95% alcohol containing 5% of glycerol. A drop of this reagent yields characteristic crystals of potassium picrate when added to a drop of a solution containing a potassium salt. Ammonium and sodium salts do not yield crystals, but small crystals may, however, appear at the edge of the drop where more rapid evaporation occurs. When applied as a microchemical test, the limit of sensitiveness is about 0·01 mg. of potassium. To estimate potassium, the potassium picrate precipitate may be collected, washed with ether, dried under reduced pressure, and weighed, or the precipitate may be dissolved and titrated with quinine hydrogen sulphate solution; in very dilute sulphuric acid solution quinine sulphate precipitates picric acid completely. W. P. S.

Use of Hypophosphorous Acid in Gravimetric Analysis. Estimation of Silver and its Separation from Lead and other Metals. L. MOSER and TH. KITTL (*Zeitsch. anal. Chem.*, 1921, **60**, 145—161).—The boiling solution of silver nitrate is treated with an excess of hypophosphorous acid and, when the black precipitate of silver has coagulated it is collected, washed with hot water, dried, and weighed. The authors find that the use of hot water for washing the precipitate does not cause the latter to pass through the filter as stated by Mawrow and Mollow (A., 1909, ii, 183). The silver nitrate solution must be neutral and the concentration not more than $N/20$, otherwise hypophosphorous acid is occluded by the precipitate. The separation of silver from lead, zinc, cadmium, etc., depends on the solubility of the hypophosphites of these metals in hot water. W. P. S.

Separation and Estimation of the Alkaline-earth Metals. (MLLE) VIRGINIE TEODOSSIU (*Bul. Soc. Chim. România*, 1921, **3**, 34—40; compare this vol., i, 540).—A solution containing calcium, strontium, and barium salts is heated with sulphuric acid, cooled, mixed with twice its volume of alcohol, and, after four hours, the supernatant liquid is decanted through a filter. The precipitate containing the mixed sulphates is then treated with a few drops of ammonia to neutralise the remaining sulphuric acid and ammonium citrate solution is added; the latter dissolves the calcium sulphate and, after three hours, the solution is separated by filtration from the insoluble strontium and barium sulphates and the calcium estimated in the filtrate. The barium and strontium sulphates are then ignited, boiled with ammonium carbonate solution, the strontium carbonate is dissolved by the addition of hydrochloric acid, and the solution separated from the insoluble barium sulphate. The ammonium citrate solution is prepared by dissolving 42 grams of citric acid in water, neutralising the solution with ammonia, and diluting it to 1 litre. W. P. S.

Gravimetric Analysis. XVII. Estimation of Zinc. L. W. WINKLER (*Zeitsch. angew. Chem.*, 1921, **34**, 235—236).—In the absence of potassium salts, zinc may be estimated by precipitating it as ammonium zinc phosphate. The zinc solution, measuring 100 c.c. and containing about 0·1 gram of zinc, is treated with 2 grams of ammonium chloride, boiled, and 10 c.c. of 20% diammonium hydrogen phosphate solution are added. After eighteen hours, the precipitate is collected, washed with 50 c.c. of water saturated previously with ammonium zinc phosphate, dried at 130°, and weighed, or the precipitate may be ignited and weighed as zinc pyrophosphate. For a weight of about 0·3 gram of precipitate, a correction of +0·3 mg. is made for the dried precipitate, and of +0·9 mg. in the case of the ignited precipitate. W. P. S.

Estimation of Mercury in its Ores. A. HEINZELMANN (*Chem. Zeit.*, 1921, **45**, 657—658).—The finely-pulverised ore is placed in a thin-walled tube, 170 mm. × 17 mm. diam., and mixed with an equal amount of lime; a layer of lime and a small quantity of

long-fibre asbestos are placed above the mixture. In presence of much sulphur, iron filings must be added. The tube is loosely clamped in an almost horizontal position, and the mixture is heated for two to three minutes over a small flame, and then strongly for ten minutes, the tube being rotated at intervals. The portion of the tube containing the sublimed mercury is cut off, the mercury is dissolved in nitric acid (*d* 1·48—1·50), a few drops of *N*/10-potassium permanganate are added, and the solution is titrated with *N*/20-potassium thiocyanate solution. W. J. W.

Volumetric Estimation of Aluminium in its Salts. ALFRED TINGLE (*J. Ind. Eng. Chem.*, 1921, **13**, 420—422).—Comparison of methods for the estimation of aluminium by titrating its salt in solution with sodium hydroxide solution, using phenolphthalein as indicator, showed that two only are trustworthy. In the first, the aluminium sulphate solution is boiled and titrated with *N*/2-sodium hydroxide solution until the pink colour of the indicator persists after boiling for one minute. The second method is similar except that the aluminium sulphate solution is treated with an excess of barium chloride before being titrated; this method has some slight advantage over the first, particularly if iron salts are present, as the colour of the iron is masked by the barium sulphate. W. P. S.

Oxidimetric Estimation of Manganese in Hydrofluoric Acid Solution. JOSEF HOLLUTA and JOSEF OBRIST (*Monatsh.*, 1921, **41**, 555—571).—Manganese can be estimated in accordance with the equation: $MnO_4' + 4Mn^{\cdot\cdot} + 8H^{\cdot} = 5Mn^{\cdot\cdot\cdot} + 4H_2O$ under the following conditions. The neutral or faintly acid solution of the manganous salt, which must not contain more than 0·2 gram Mn, is placed in a 850—1000 c.c. Erlenmeyer flask and diluted to 300 c.c.; after addition of sulphuric acid (1 : 7, 5—10 c.c.) and ammonium fluoride (5 grams), the cold solution is titrated with *N*/10-permanganate. The greater part of the latter is immediately decolorised, but sooner or later, in accordance with the amount of manganese present, the liquid becomes reddish-yellow. The end-point is fixed by observation of the absorption spectrum of the solution with a pocket spectroscope, a matt 50 c.p. metallic filament lamp being used as source of illumination. The titration is considered to be finished when the bands at 547·3 and 525·6$\mu\mu$ persist for more than five minutes. An excess of fluorine ions, low hydrogen-ion concentration, low temperature, and considerable dilution are essential. The presence of ferric iron in large amount, of chlorine, and of nitrate ions causes no disturbance. If the titre of the permanganate is estimated by the fluoride method, the results are as accurate as those of the best volumetric methods described hitherto. H. W.

Approximate Estimation of Iron and Manganese in Systematic Qualitative Analysis. L. J. CURTMAN and N. H. HECHT (*Chem. News*, 1921, **122**, 254—255).—A hydrochloric acid solution containing iron, aluminium, chromium, manganese, and zinc is boiled with the addition of sodium hydroxide and sodium peroxide, the precipitated ferric hydroxide, etc., is collected, dissolved in

dilute hydrochloric acid, potassium thiocyanate is added, and the mixture titrated with standardised stannous chloride solution. To estimate the manganese, another portion of the original hydrochloric acid solution is treated as described with sodium hydroxide and peroxide, the precipitate collected, washed until free from chlorides, dissolved in nitric acid, the manganese oxidised by sodium bismuthate under the usual conditions, and the resulting permanganate titrated with standardised hydrogen peroxide solution.

W. P. S.

Reductions with Zinc and Cadmium in Volumetric Analysis. W. D. Treadwell (*Helv. Chim. Acta*, 1921, **4**, 551—565).—The rapid reduction of solutions of ferric salts by finely-divided zinc only occurs in solutions which are but slightly acid, and the danger is then present that a portion of the iron may be deposited on the zinc; in addition, it is difficult to devise a satisfactory correction for the iron present as impurity in the zinc. These disadvantages can be circumvented by substituting cadmium for zinc, the metal being obtained in a sufficiently finely-divided and non-spongy condition by the electrolysis of concentrated cadmium sulphate solution acidified with sulphuric acid between platinum electrodes; the size of the particles can readily be controlled by altering the current density. Reduction of the ferric sulphate solution occurs very rapidly and without noticeable evolution of hydrogen. The degree of acidity of the solution has no effect on the reaction. The method is well adapted to the estimation of very small quantities of iron.

[With A. Rheiner.]—Quadrivalent titanium is also quantitatively reduced by finely-divided cadmium. Titanium and iron may be estimated simultaneously by complete reduction, followed by titration with standard potassium permanganate; the end-points are conveniently determined electrometrically, or, if this method is not available, by use of potassium thiocyanate as outside indicator. In like manner, molybdenum trioxide is quantitatively reduced to the sesquioxide. Ammonium vanadate is uniformly reduced to the stage $V_2O_{2\cdot046}$; possibly the slight divergence from the bivalent stage is due to reoxidation. The experiments are best performed by running the reduced solution directly into an excess of standard permanganate and titrating the latter with oxalic acid. Uranyl sulphate is likewise smoothly reduced, and the concordance of the results makes it probable that the action proceeds exactly to the uranous stage, but this matter is one for further examination.

H. W.

A Micro-method for the Estimation of Iron in Organic Combination. Maurice Nicloux and Georges Welter (*Bull. Soc. Chim. Biol.*, 1921, **3**, 170—173).—The method depends on the conversion of the iron into ferric oxide by ignition of the organic compound, and the subsequent reduction of the oxide to metallic iron by heating in a current of hydrogen; the loss of weight on reduction is taken as a measure of the iron present. The method is only applicable to pure compounds. C. R. H.

Use of Cupferron [Ammonium Salt of Nitrosophenylhydroxylamine] in the Separation of Zirconium from Uranium. A. ANGELETTI (*Gazzetta*, 1921, **51**, i, 285—288).—In estimating zirconium and uranium present together, the former may be precipitated by means of cupferron in an acid medium, the uranium being subsequently precipitated by excess of ammonia solution as ammonium uranate, which is calcined in a current of hydrogen and weighed as UO_2; the small proportion of cupferron left in the filtrate does not interfere with the precipitation of the uranium. T. H. P.

Quantitative Separation of Arsenic, Antimony, and Tin. FRIEDRICH L. HAHN and PETER PHILIPPI (*Zeitsch. anorg. Chem.*, 1921, **116**, 201—205).—The method devised by Hahn (A., 1916, ii, 266) for the detection and qualitative separation of these elements can be used for their estimation. The precipitated sodium pyroantimonate adheres obstinately to the sides of the vessel and cannot therefore be weighed directly. The method adopted is as follows. After the sulphide solution has been completely oxidised with hydrogen peroxide, 80% alcohol equal to one-third of the volume of the solution is added, and after twenty-four hours the solution is filtered. The precipitate is washed with alcohol of increasing strength containing a little sodium carbonate, then dissolved in dilute hydrochloric acid containing tartaric acid, and transferred to the vessel in which it was precipitated, to dissolve the portion adhering to the vessel. The antimony can then be estimated by precipitation as sulphide. From the filtrate after evaporation of the alcohol, the tin is precipitated by addition of ammonium nitrate and weighed as SnO_2, and the arsenic finally determined by precipitation as magnesium ammonium arsenate. [Compare *J. Soc. Chem. Ind.*, 1921, Aug.] E. H. R.

Estimation of Glycerol in Wine by Conversion into Acraldehyde by means of Boric Acid. A. HEIDUSCHKA and F. ENGLERT (*Zeitsch. anal. Chem.*, 1921, **60**, 161—166).—The extract from 100 c.c. of wine is transferred to a small retort with 15 c.c. of water, evaporated to a volume of about 2 c.c., 1 gram of boric acid is added, and the heating continued until all water has been expelled. The retort is then connected with receivers containing ammonia and cooled in an ice and salt mixture, and the temperature is raised to 320°, a current of air being passed into the tubulus of the retort. After forty-five minutes, the receivers are disconnected, their contents mixed, 5 c.c. of $N/10$-silver nitrate solution are added, the mixture heated for about twenty minutes, and filtered. The excess of silver nitrate is titrated in the filtrate. The amount of glycerol corresponding with the volume of silver nitrate solution reduced is found by reference to a table. W. P. S.

Quantitative Test of the Thermal Stability of Glyceryl Nitrate Explosives. M. TALIANI (*Gazzetta*, 1921, **51**, i, 184—193).—The author describes an apparatus and method for following the gradual increase of the pressure developed when an explosive is maintained in a closed space at a constant temperature; glyceryl

nitrate and explosives derived from it are kept at 120° and cellulose nitrates at 135°. For a number of explosives the pressure–time curves have been traced, the results showing that these curves serve to characterise the different explosives with nitric esters as bases. [Compare *J. Soc. Chem. Ind.*, 1921, Aug.] T. H. P.

Generalisation of Salkowski's, Liebermann's, and Schiff's Reactions [for Cholesterol]. GALAVIELLE, PORTES, and CRISTOL (*Bull. soc. sci. médit. biol. Montpelier*, 1921, **2**, 129—132; from *Physiol. Abstr.*, 1921, **6**, 238—239).—In their work on the elimination of terpenes, the authors found that the above reactions for cholesterol sometimes give the same colour with these substances, but in other cases they are different. Schiff's reaction (solution in nitric acid, careful evaporation, and addition of ammonia) gives a yellow coloration with the acid and red with ammonia. This occurs with cholesterol and all terpenes examined, except menthol; in that case ammonia only deepens the yellow. The material, when simply touched with sulphuric acid, gives red with cholesterol, terpene, Borneo, sassafras, and buchu camphors, and terebenthene; yellow with Japanese camphor and synthetic camphor; brown with menthol. Salkowski's reaction (addition of sulphuric acid with agitation to a solution in chloroform) gives a red in the chloroform and green fluorescence in the acid with cholesterol; with terpene, the chloroform is not coloured and the acid is orange-red; with Japanese and synthetic camphor, the chloroform shows a yellow fluorescence and the acid is golden-yellow; with Borneo camphor and terebenthene, the chloroform is yellow and the acid orange-red; with sassafras-camphor, the chloroform is faint yellow and the acid cherry-red; with buchu-camphor the same occurs, except that the chloroform is only fluorescent; with menthol, the chloroform becomes cloudy and the acid orange. In Liebermann's reaction (addition of acetic anhydride and sulphuric acid to the solution in chloroform) cholesterol gives blue; terpene an evanescent yellow; Japan and synthetic camphor nil; Borneo camphor, buchu-camphor, and terebenthene reddish-brown; sassafras-camphor gold; and menthol cherry-red. E. S.

An Improved Form of Barfoed's Reagent. H. E. ROAF (*Proc. Physiol. Soc.*, 1920, *J. Physiol.*, 1921, **54**, lx—lxi; from *Physiol. Abstr.*, 1921, **6**, 170).—The most satisfactory reagent was found to be: copper acetate, 50 grams; sodium acetate, 50 grams; glacial acetic acid, 5 c.c.; water to 1000 c.c. With this reagent a reduction is obtained with 0·1% dextrose solution on merely heating to the boiling point, whilst 1% solutions of pure specimens of maltose or lactose do not show reduction under similar conditions. E. S.

Estimation of Dextrose in Glucosides. AL. IONESCU (*Bull. Soc. Chim. România*, 1921, **3**, 6—9).—A volumetric method, using ferricyanide, described recently by the author (this vol., ii, 220) may be applied to the estimation of dextrose resulting from the hydrolysis of certain glucosides. In the case of amygdalin, the hydrocyanic acid and benzaldehyde formed during the hydrolysis

must be expelled by heating the solution before the sugar is estimated. W. P. S.

A New Reagent for the Estimation of Sugar in Urine. J. B. SUMNER (*Proc. Amer. Soc. Biol. Chem., J. Biol. Chem.*, 1921, **46**, xxi; from *Physiol. Abstr.*, 1921, **6**, 170).—4 : 6-Dinitroguaiacol is reduced to the intensely-coloured 4-nitro-6-aminoguaiacol when heated with solutions of dextrose in the presence of sodium carbonate. The reaction is quantitative, and lends itself to the colorimetric estimation of dextrose. The new reagent is not reduced by other urinary constituents. E. S.

Estimation of Dextrose, Lævulose, Sucrose, and Dextrin in the Presence of Each Other. A. BEHRE (*Zeitsch. Nahr.-Genussm.*, 1921, **41**, 226—230).—The dextrose is estimated iodometrically by the method described by Willstätter and Schudel (A., 1918, ii, 337); if the estimation is repeated after a portion of the sample has been heated with hydrochloric acid to invert the sucrose, the difference between the two estimations gives the amount of dextrose formed from the sucrose, and the quantity of the latter may be calculated. The method may also be used for the estimation of dextrose and dextrin in commercial "starch syrup," the additional quantity of dextrose found after the sample has been heated with hydrochloric acid for three hours being a measure of the dextrin. The authors have not yet determined the effect on the results due to the maltose which is present in "starch syrup." Lævulose may be estimated in a mixture of sugars by determining the cupric-reducing power after the dextrose has been oxidised by iodine in alkaline solution and the resulting gluconic acid removed by treatment with lead acetate. W. P. S.

The Official Method for the Estimation of Hydrocyanic Acid. C. E. CORFIELD and C. J. EASTLAND (*Pharm. J.*, 1921, **106**, 482—483).—Excess of ammonia interferes with the estimation of hydrocyanic acid by the method described in the British Pharmacopœia, the error increasing with increased concentration of the ammonia. Increase in the amount of potassium iodide used has no effect until the quantity added exceeds 10 c.c. W. P. S.

Estimation of Lecithin. J. L. B. VAN DER MARCK (*Pharm., Weekblad*, 1921, **58**, 989—992).—The estimation of phosphate in lecithin by the molybdate method is tedious and apt to give erroneous results. The author recommends precipitation as magnesium ammonium phosphate, after the customary removal of organic matter by means of nitric and sulphuric acids. Some doubt exists as to the correctness of the formula $C_{42}H_{84}O_9NP$ for lecithin and the purity of samples cannot therefore be determined from the ratio : $P_2O_5=2C_{42}H_{84}O_9NP$. W. J. W.

Estimation of Formaldehyde. C. KOLLO and O. LASCAR (*Bul. Soc. Chim. România*, 1921, **3**, 3—6).—A modification of Legler's method is described in which the hexamethylenetetramine formed is precipitated by the addition of an excess of picric acid, the precipitate removed by filtration, and the excess of picric acid

then titrated. Ten c.c. of a solution containing about 1 gram of formaldehyde are treated with 5 c.c. of ammonia, (*d* 0·960), and, after thirty minutes, the mixture is heated at 60° until the excess of ammonia has been expelled. The mixture is then cooled, treated with 50 c.c. of *N*/20-picric acid solution, diluted to 100 c.c., filtered after thirty minutes, and 50 c.c. of the filtrate are titrated with *N*/10-sodium hydroxide solution, methyl-red being used as indicator. Each c.c. of *N*/20-picric acid solution is equivalent to 0·009 gram of formaldehyde. W. P. S.

Titration of certain Alkaloids. NORMAN EVERS (*Pharm. J.*, 1921, **106**, 470—472).—Bromophenol-blue is the most suitable indicator for use in the titration of morphine, atropine, and normal quinine salts, and methyl-red in the titration of quinine hydrogen salts. W. P. S.

Analysis of Theobromine Sodium Salicylate. C. T. BENNETT and F. B. WINDLE (*Pharm. J.*, 1921, **106**, 472).—The following modification of the British Pharmacopœia method is recommended: Two grams of the dried salt are dissolved in 10 c.c. of water and the solution is titrated with *N*/1-hydrochloric acid, using phenolphthalein as indicator; not more than 5·5 c.c. of the acid should be required. The solution should now be slightly alkaline in reaction towards litmus; if not, a drop of dilute ammonia is added. After three hours, the precipitated theobromine is collected, washed with four quantities of 5 c.c. each of cold water, dried at 100°, and weighed; 0·13 gram is added to the weight found. The filtrate from the theobromine precipitate is treated with 5.5 c.c. of *N*/1-hydrochloric acid and extracted with four quantities of 10 c.c. of ether. The ethereal solution is washed with 10 c.c. of cold water, 50 c.c. of water are then added, and the salicylic acid is titrated with *N*/1-sodium hydroxide solution, using phenolphthalein as indicator. W. P. S.

Potassium–Zinc Ferrocyanide as a Precipitant for Urines. Its Application to the Separation and Estimation of Uric Acid and Xanthine Bases. THIÉRY (*J. Pharm. Chim.*, 1921, **23**, 494—503).—Two hundred c.c. of the urine are treated with 25 c.c. of a mixture of equal volumes of *N*/10-silver nitrate solution and a solution containing 150 grams of ammonium chloride and 100 grams of magnesium chloride per litre of ammonia, *d* 0·922; the treated urine is then filtered, and to 100 c.c. of the filtrate are added 10 c.c. of alkaline *N*/10-potassium cyanide solution and 20 drops of 10% potassium iodide solution containing 2% of ammonia, and the solution is titrated with *N*/10-silver nitrate solution until a persistent turbidity is obtained. The number of c.c. of *N*/10-silver nitrate solution used for the titration is multiplied by 0·21 to obtain the sum of the uric acid and xanthine bases (in terms of uric acid) expressed as grams per litre of urine. Another portion of 200 c.c. of the urine is treated with 20 c.c. of 15% potassium ferrocyanide solution and 20 c.c. of 11·2% zinc acetate solution; this precipitates the xanthine bases, and, after the mixture has been filtered, the uric acid alone is estimated in 110 c.c. of the

filtrate as described above. The difference between the two estimations gives the xanthine bases in terms of uric acid.

W. P. S.

Detection of Fluorescein in Very Dilute Solutions. MAURICE LOMBARD (*Bull. Soc. chim.*, 1921, [iv], **29**, 462—464).—To 30 c.c. of the solution a few drops of dilute sulphuric or hydrochloric acid, free from chlorine, are added, and then the solution is shaken with a small amount of ether. When the ether has separated, the ethereal layer being about 3 mm. thick, a few drops of aqueous ammonia are added and the tube is gently shaken round. The ethereal layer becomes green if fluorescein is present in the original solution, and the green colour passes gradually into the aqueous layer underneath. By this method it is possible to detect fluorescein at a dilution of 1 in 200,000,000. By using 200 c.c. of solution and slightly modifying the process by making a double ethereal extraction, it is possible to make the test sensitive at a dilution of 1 in 500,000,000. If an emulsion forms, tending to prevent the separation of the ethereal layer, one drop of alcohol is added.

W. G.

Characterisation of Amylase Solutions. H. VON EULER and OLOF SVANBERG (*Zeitsch. physiol. chem.*, 1921, **112**, 193—230).—The authors introduce a new and more absolute measure *Sf* for the activity of amylase preparations, analogous to that (*If*) previously recommended by them for invertase preparations (*Zeitsch. physiol. Chem.*, 1919, **106**, 201).

$Sf = K \times$ maltose (in grams)/enzyme preparation (in grams) where K is the constant of the unimolecular reaction according to which the first major portion of the hydrolysis proceeds and the maximum amount of maltose which can be formed. By calculation it is found: 1000 Lintner units=26 *Sf*; 1000 units of the "new scale" of Sherman and collaborators (A., 1910, ii, 1012; 1915, i, 183)=38·5 *Sf*. It is suggested that the reaction constant should be measured at 37° with soluble, previously boiled starch, prepared according to Lintner, in a concentration of 0·72—2·8% and with enzyme concentrations which under these conditions give a constant between 0·004 and 0·08. The optimum P_H should be secured, which the authors find to be =5. The paper contains a review of the earlier literature.

G. B.

Exact Demonstration of Tyrosinase. The Tyrosinase Reaction. HUGO HAEHN (*Fermentforsch.*, 1921, **4**, 302—315. Compare A., 1920, i, 777).—The presence of tyrosinase is best proved by the action of α-tyrosinase, after separation and activation with different neutral salts, on solutions of tyrosine. Characteristic colour reactions are obtained which differ with the particular salt used. By this method, the similarity of the tyrosinase in potatoes, red mushrooms, and meal-worms is established. The function of the salt is twofold: it first activates the α-tyrosinase and finally precipitates the colloidal melanin.

E. S.

General and Physical Chemistry.

Refraction of Light of Non-associated Liquids. W. Herz (*Zeitsch. Elektrochem.*, 1921, **27**, 323—324).—A theoretical paper in which it is shown that the value of the refractive index and the molecular refraction of non-associated liquids may be approximately calculated from the density at any given temperature and the critical density together with the latent heat of vaporisation and the ebullioscopic constant. The formulæ $MR=1\cdot8T_s/d_cL$, and $MR=0\cdot9C/d_cT_s$ represent the relationships, and in most cases give values of MR which are in keeping with known data for non-associated liquids. The refractive index of all non-associated liquids at the critical point has the value 1·126. J. F. S.

Theory of Molecular Refractions. II. Free and Activated Valencies. Gervaise Le Bas (*Chem. News*, 1921, **123**, 56—58; see this vol., ii, 361).—From a consideration of molecular refractions the existence of free valencies of carbon, sulphur, and nitrogen in unsaturated compounds is inferred. The common cause of the regularities observed is supposed to be the existence of displaced electrons in the unsaturation centres. Further cases of negative anomalies are cited. J. R. P.

Critical Potentials and the Band Spectra of Nitrogen. Léon Bloch and Eugène Bloch (*Compt. rend.*, 1921, **173**, 225—227; cf. A., 1920, ii, 402).—It has been shown (*loc. cit.*) that the positive band spectrum of nitrogen appears at a potential of about 12 volts. Using a modified form of apparatus, it is now shown that the negative band spectrum appears suddenly at a well-defined critical potential of $21\cdot5\pm0\cdot5$ volts. W. G.

A New Spectrum of Cæsium. L. Dunoyer (*Compt. rend.*, 1921, **173**, 350—352).—By exciting the luminosity of cæsium vapour by electromagnetic induction, the author has obtained a spectrum showing six hundred and thirty rays between $\lambda=2250$ and 6300. The spectrum varies somewhat with the pressure of the vapour. The principal rays are tabulated. W. G.

Spectra of the Alkaline-earth Fluorides and their Relation to each other. Snehamoy Datta (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 436—455).—The band spectra of the fluorides of magnesium, calcium, strontium, and barium have been photographed and measured. The measurements were made in the second order spectrum, using a grating of 10 ft. radius and 15,000 lines to the inch. The compounds were introduced along with sodium carbonate into a carbon arc of 110 volts and the edge of the arc was photographed. Nine series of bands have been found in the spectrum of magnesium fluoride. Four new series have been found for calcium fluoride in the ultra-violet, and additional heads recorded

in some of the series in the visible region. Four new series have been found in the ultra-violet for strontium fluoride, and a very weak one in the red. Series designated H_1, H_2, H_3, H_4, and attributed by Leopold (*Zeitsch. Wiss. Photochem.*, 1913, **11**, 105, 137) to strontium fluoride, and the same series termed F_1, F_2, F_3 by George (A., 1913, ii, 646), and attributed to barium fluoride, are really due to calcium fluoride, and are now termed B_2, B_2', B_2'', and B_2'''. The homologous series of the alkaline-earth fluorides have been connected by empirical equations, using the constants of the series and the molecular weights or the molecular numbers of the respective compounds. An explanation is given of the appearance of a "tail" in some of the bands, starting with their series equations. It is also shown that the difference in wave numbers of the heads and tails of the similar series is constant for the same compound, but varies from one to another in a definite way.

J. F. S.

Infra-red Spectra of Isotopes. F. W. Loomis (*Astrophys. J.*, 1920, **52**, 248—256).—No satisfactory explanation has been given of the magnitude of the differences observed in the spectra of lead isotopes. Much larger effects should be expected for any vibration in which two atoms or nuclei, instead of one atom and an electron, are the principal masses concerned. The infra-red absorption bands of hydrogen chloride and hydrogen bromide would, in view of the complex nature of chlorine and bromine, be expected to be doublets due to isotopes. Further, there is little doubt that the central frequency of the "fundamental" band (at 3·46 μ for hydrogen chloride and 3·91 μ for hydrogen bromide) is the frequency of vibration of the charged halogen atom and the hydrogen nucleus along their line of centres. It is now shown that the frequencies of the doublets due to isotopes should be approximately proportional to $\sqrt{(m_1+m_2)/m_1m_2}$, where m_1 is the mass of the hydrogen nucleus and m_2 that of the charged halogen atom; hence the band lines due to $HCl^{(35)}$ and $HCl^{(37)}$ should differ by 1/1330, and those due to $HBr^{(79)}$ and $HBr^{(81)}$ should differ by 1/6478. Examination of the absorption spectra of hydrogen chloride, bromide, and fluoride shows that each rotational quantum line in the first harmonic of the hydrogen chloride spectrum has on the long-wave side a satellite of less intensity, separated from it by an average measured interval of 14Å, or 4·5 wave numbers, which agrees with the calculated value of 4·3 wave numbers. These satellites are the predicted lines due to the heavier isotope. Fluorine has been shown to be pure, and the absorption spectrum of hydrogen fluoride accordingly consists of single lines. In the case of hydrogen bromide, the computed separations are smaller than for the harmonic of hydrogen chloride, and the lines of separate isotopes have not been resolved.

Chemical Abstracts.

Chromogenetic Properties of Sulphur and certain other Elements. Oliver C. M. Davis and Frederic William Rixon (*Phil. Mag.*, 1921, [vi], **42**, 259—262).—It would seem that the colour of a combination of two elements, in addition to the deter-

mining effect of the nature of the elements themselves, may possibly in a measure be associated with the energy of combination, and more particularly with that energy left unabsorbed from the gross energy of the system, which may be termed the residual energy.

J. R. P.

Rotatory Power in Crystalline Media. LOUIS LONGCHAMBON (*Compt. rend.*, 1921, **173**, 89—91).—A considerable number of substances optically active in solution showed, without exception, rotatory power in the crystalline state in the direction of their optical axes. It is considered that the rotatory power may be divided into molecular and structural components. Twelve compounds not optically active in solution were found to show this rotatory power of structure in crystalline form. The rotatory power of structure is a consequence of crystalline dissymmetry. W. G.

The Diffraction of *X*-Rays by Liquids. A. DEBIERNE (*Compt. rend.*, 1921, **173**, 140—142).—When a narrow bundle of *X*-rays passes through a liquid layer sufficiently thick for an important part of the radiation to be absorbed, there is obtained on a photographic plate an aureole with a dark central region, and in some cases two such rings are shown. The phenomenon is analogous to that produced with crystals in a confused mass or in powder. The hypothesis put forward in explanation is that each radiation is dispersed as from an interior cone, where the intensity is greatest, and a heterogeneous bundle of rays will give a series of rings the diameter of which will increase with the wave-length. The centres of diffraction in liquids may be considered as constituted by the molecules, the mutual distances of which undergo only slight variations by thermal agitation, or by particularly active atoms contained in these molecules. W. G.

Röntgen Spectrographic Investigations of Organic Substances of High Molecular Weight. R. O. HERZOG and W. JANCKE (*Zeitsch. angew. Chem.*, 1921, **34**, 385—387).—The difficulties of interpreting the Debye-Scherrer diagrams can be overcome to some extent if the crystals are arranged in the direction of a main axis, whereas the other axes are disposed indiscriminately; instead of concentric rings, a two- or four-point system is thus obtained. The necessary arrangement can be secured by the use of currents of fluid, of strong electric or magnetic fields, or by pressure, although the latter method is not invariably successful even when very high pressures are used.

The general result of the application of Röntgen diagrams to a large number of organic compounds is that which would be expected from experience in chemical crystallography. Thus, the members of the fatty acid series are divisible into two groups containing odd and even numbers of carbon atoms, and here, as in the case of the melting points, the initial members of the series behave abnormally. In some instances, saturated and unsaturated compounds (fatty and oleic acids, succinic, maleic, and acetylenedicarboxylic acids) exhibit remarkable similarities, whereas in

others (β-phenylpropionic and cinnamic acids, hydrazobenzene and azobenzene) the differences are so marked that they can scarcely be attributed solely to the absence of hydrogen atoms.

The applicability of the Röntgen diagrams to the elucidation of constitutional problems is particularly illustrated in the instance of cellulose. The dimensions of the elementary body are found to be, $7{\cdot}9 : 8{\cdot}45 : 10{\cdot}2 \times 10^{-8}$ cm. and the volume $680 \times 10^{-24} (\pm 2\%)$ c.c. Since, however, $V = 1{\cdot}64 \times 10^{-24} nM/s$ (where M=molecular weight, n=the number of molecules in the elementary body, V=its volume in c.c., and s=the density of the crystal) it follows that $n = 4{\cdot}03$. In other words, the elementary body of cellulose contains four dextrose residues. Since, however, the symmetry of the elementary body is not less than monoclinic and also the molecule does not contain pre-formed *l*-dextrose, it follows that the elementary body is composed of two equal fundamental portions, each containing two dextrose residues. Since, according to Freudenberg, cellulose is composed to the extent of 35—60% of cellobiose, a residue of the latter must be present in each fundamental portion and cellulose must be entirely built up of cellobiose residues. Assuming that the geometrical demands of the theory of crystalline structure must be fulfilled, the cellobiose residues must be linked in one of the following ways, (1) as a chain of dextrose residues,

$$\ldots C\text{-}C_6H_{10}O_4\text{-}O\text{-}C_6H_{10}O_4\text{-}O\text{-}C_6H_{10}O_4 \ldots,$$

these being composed of four links and not containing preformed cellobiose, (2) as rings of the type,

$$\begin{array}{l} C_6H_{10}O_4\text{-}O\text{-}C_6H_{10}O_4\text{-}O \\ O\text{-}O_4H_{10}C_6\text{-}O\text{--}O_4H_{10}C_6 \end{array},$$

or (3) as internal anhydrides of cellobiose, $2(C_{12}H_{20}O_{10})$. H. W.

The Fine Structure of the *X*-Ray Series. D. COSTER (*Compt. rend.*, 1921, **173**, 77—79).—The author has remeasured the L spectra of the elements from tantalum to uranium. He concludes that the two lines γ_2 and γ_3 are really three. There are two lines γ_2 and γ_3 which have an almost constant difference in wave-length from tantalum to uranium, and almost the same intensity. In addition, there is a line γ_6 which forms a doublet L with β_5. It crosses the line γ_2 in platinum and gold and the line γ_3 in lead and bismuth. The difference in wave-length γ_1—γ_6 is constant from tantalum to uranium. These three lines were separated in four elements, tantalum, tungsten, thallium, and uranium. In addition, the probable existence of two new lines β_9 and β_{10} has been shown. Lines such that their frequency is the sum of the frequencies of two other lines apparently do not exist. W. G.

The Distribution of the Electrons in the Heavy Atoms. A. DAUVILLIER and L. DE BROGLIE (*Compt. rend.*, 1921, **173**, 137—139).—A further discussion of the authors' own work (this vol., ii, 421, 475) and that of Coster (preceding abstract) in which the slight difference between their scheme for the distribution of energy in the heavy atoms and that of Bohr is explained.

W. G.

Disappearance of Gas in the Electric Discharge. III. THE RESEARCH STAFF OF THE GENERAL ELECTRIC CO., LONDON (*Phil. Mag.*, 1921, [vi], **42**, 227—246).—A summary of previous communications (see A., 1920, ii, 730; this vol., ii, 369), with some new experiments and a theoretical discussion of the results. Except in hydrogen, absorption of gas occurs only if there is a glow discharge, and is closely associated with the ionisation of the gas absorbed. If the area of the electrodes is small compared with the walls of the discharge tube, the latter may act as a third electrode, receiving positive ions, the charge on which is neutralised by electrons from the cathode. The reaction $2CO=CO_2+C$, which plays a predominant part in the absorption of carbon monoxide, occurs by collision of a positive carbon monoxide ion with a neutral carbon monoxide molecule, and under ideal conditions the current appears to be carried by a " semi-valent " ion. Usually this simple relation is obscured by the reversibility of the reaction, recombination of ions, and arrival of positive ions at the cathode. Similar difficulties may have rendered illusory most of the cases previously recorded of the apparent exhibition of Faraday's law in gases. Preliminary experiments with nitrogen indicate an absorption proportional to ionisation, but the reactions involved are more complex. The " clean-up " of hydrogen seems entirely independent of ionisation. A luminous discharge may be obtained, showing the many-lined spectrum, without any appreciable recombination occurring.

J. R. P.

The Resistance of Selenium. H. PÉLABON (*Compt. rend.*, 1921, **173**, 295—297).—The electrical conductivity of liquid selenium increases rapidly with rise in temperature up to its boiling point, 690°. On cooling it again, the conductivity decreases with the same velocity. The slow cooling of selenium first melted and then heated at 690° results in the production at the ordinary temperature of a grey selenium, the conductivity of which is not constant for a given temperature, but can be diminished at will by slight heating and cooling. This form of selenium does not undergo reversible transformations, its properties varying with the states through which it passes.

W. G.

The Electrical Resistance of Thallium Sulphide and Selenide. H. PÉLABON (*Compt. rend.*, 1921, **173**, 142—144).—Measurements are given showing that the electrical resistance of thallous sulphide varies considerably with the method of preparing the sample and the conditions of heating. A sample that may be considered as tempered has, as a rule, a very high resistance, which, however, varies enormously with the degree of tempering. It diminishes rapidly with rise in temperature to 205° and then rises slightly to a maximum at 220°, after which it diminishes regularly. The passage into the liquid state is accompanied by a sudden variation in the resistance. Similar results were obtained with thallous selenide.

W. G.

Regulation of Osmotic Pressure. I. The Effect of Increasing Concentrations of Gelatin on the Conductivity of a Sodium Chloride Solution. WALTER W. PALMER, DANA W. ATCHLEY, and ROBERT F. LOEB (*J. Gen. Physiol.*, 1921, **3**, 801—807).—The conductivity of pure gelatin solutions increases with the concentration of the solutions and is independent of the hydrogen-ion concentration. The actual specific conductivity is, however, higher at that hydrogen-ion concentration when the ionisation is greater. When gelatin is added in increasing concentrations to a 0·6% sodium chloride solution, the conductivity of the solution increases with each increment at the reaction when the gelatin is highly ionised but decreases at the reaction when the gelatin is less ionised.

S. S. Z.

The Conductivity of the Solution of Cupric Ammonium Citrate compared with that of Copper Sulphate. F. BEAULARD DE LENAIZAN and L. MAURY (*Compt. rend.*, 1921, **173**, 227—229).—Comparison of the electrical conductivities of solutions of copper sulphate and cupric ammonium citrate containing the same weight of copper per litre shows that for the sulphate dissociation is complete at a dilution of 1 mg. of copper per litre whilst for the citrate it is complete at a dilution of 1 gram of copper per litre. The ionisation of cupric ammonium citrate, like that of copper sulphate, obeys the law of Arrhenius and the cupric ion is free to the same degree in the two salts.

W. G.

Electromotive Force of the Iodine–Silver Element and the Heat of Formation of Silver Iodide. O. GERTH (*Zeitsch. Elektrochem.*, 1921, **27**, 287—292).—The heat of formation of silver iodide has been redetermined by the *E.M.F.* method with the object of explaining the discrepancy between the results of Fischer (A., 1912, ii, 536, 1054) and Jones and Hartmann (A., 1915, ii, 308). It is shown that the discrepancy arises from a difference in the silver electrodes used in the two cases and from the correction applied to the *E.M.F.* values. The correction, which depends on the presence of I_3' in the potassium iodide solutions employed, was found in the above-named cases by calculation. The present paper indicates how this value may be obtained experimentally. The experimental measurements of the above-named authors have been repeated and confirmed; comparison of the silver electrodes used in the two cases shows that the Fischer electrode is electrochemically purer. An attempt is made to eliminate the above-named correction by using very dilute solutions of potassium iodide in the silver–iodine elements and thereby removing the disturbing effect of the I_3'. The progressively increasing inconstancy of the elements with decreasing potassium iodide concentration makes it impossible to go beyond $N/60$. A new method, however, gives the desired results. In this, very dilute solutions of iodine are obtained without further decreasing the potassium iodide concentration. By leading nitrogen (or other indifferent gas) over cooled iodine and then into a dilute solution of potassium iodide, small concentrations of iodine are obtained which correspond

with the partial pressure of the iodine and contain very little I_3'. Using the corrections thus obtained, the observed *E.M.F.* values of the iodine–silver element were corrected and the true values obtained, and from a knowledge of *A* and dA/dT the heat of formation of silver iodide was calculated. The value 15,158 cal. was obtained, which, compared with 15,169 cal. (Fischer) and 14,570 (Jones and Hartmann), points to the greater accuracy of the former value. J. F. S.

Electromotive Behaviour of Aluminium. A. GÜNTHER-SCHULZE (*Zeitsch. Elektrochem.*, 1921, **27**, 293—295).—A criticism of Smits's paper (A., 1920, ii, 579) in which it is shown that the statements (i) that commercial aluminium is not coated with a thin film of oxide, and (ii) that anodically polarised aluminium has no primary oxide layer, are both opposed to all known facts. The hypothesis of Smits that in normal circumstances aluminium separates electrons only extremely slowly and that this process is greatly accelerated by charging with oxygen is shown to be untenable. Further, the production of an insulating metal layer in the electrolytic formation in aluminium is also untenable. J. F. S.

Magnetic Properties of the Alkaline-earth Metals in Combination. PAUL PASCAL (*Compt. rend.*, 1921, **173**, 144—146).—Further measurements are given in confirmation of previous work (A., 1914, ii, 97, 618) showing that the diamagnetism of the alkaline-earth metal is additive in combination as salts. W. G.

New Data in Thermochemistry. WOJCIECH SWIENTOSLAWSKI (*Bull. Soc. chim.*, 1921, [iv], **29**, 496—499).—Combining his own results (A., 1909, ii, 862, 863, 864; 1910, ii, 187) with those of Fajans (A., 1920, ii, 469), the author deduces values for the heat of formation of any linking such as $(C-X)$ or $(H-X)$ and shows that it may be considered as made up of two parts, one part being produced by the atom $(C-)$ or $(H-)$ and the other by the atom to which it is linked. Values are calculated for carbon and the halogen atoms. It is shown that the heat produced by the atom in the formation of a compound $X-Y$ is not always equal to the heat produced by it in the formation of the simple molecule $X-X$. W. G.

The Ratio of the Densities of Liquid and Vapour. WOJCIECH SWIENTOSLAWSKI (*Bull. Soc. chim.*, 1921, [iv], **29**, 499—507.—On the basis of the physical constants of a number of compounds as determined by different workers, it is shown that the ratio k of the density of the liquid d_e to that of the vapour d_v is a function of the relative temperature $\tau = T/T_c$ and as a first approximation does not depend on the individual properties of the liquid. Certain physico-chemical properties of liquids are considered in the light of this. W. G.

A New Constant Characterising the System Vapour–Liquid. WOJCIECH SWIENTOSLAWSKI (*Bull. Soc. chim.*, 1921, [iv], **29**, 507—512; cf. preceding abstract).—The value of B in the equation

$B=d_e^2/T\log K$, where d_e is the density of the liquid and $K=d_e/d_v$ remains practically constant for liquids which are not associated. It shows a slight maximum at the point $T/T_c=0\cdot60$ to $0\cdot65$ and a slight minimum at the point $T/T_c=0\cdot85$ to $0\cdot90$. In the case of associated liquids, the value of B increases continually with the temperature and shows no maximum or minimum. W. G.

Atomic Volume and Molecular Volume at the Absolute Zero. RICHARD LORENZ and W. HERZ (*Zeitsch. anorg. Chem.*, 1921, **117**, 267—270).—The authors show that the relationship between the molecular volume of a compound and the sum of the atomic volumes, in connexion with the energetic considerations of the spatial lattice, is best made at the absolute zero. The atomic volumes of the alkali metals, the halogens, and their compounds have therefore been calculated for this temperature. It is shown that the molecular volume of the compound is always much greater than the sum of the atomic volumes of the constituent atoms. Taking a given metal, the contraction is greatest in the case of the fluoride and least in the case of the iodide; and for a given halogen the contraction is greatest with cæsium and least with sodium. The same rule applies in the case of the sulphates and the nitrates. The biggest contraction calculated is that in the formation of cæsium fluoride, which amounts to 60·0%. J. F. S.

True Molecular Volume of Liquid Organic Compounds and its Dependence on the Structure of the Molecule. EDGAR WÖHLISCH (*Zeitsch. Elektrochem.*, 1921, **27**, 295—301).—It is shown that a comparison of the molecular volumes of organic liquids at the boiling point gives in most cases an inaccurate representation of the true molecular volumes. More suitable, for investigations on the constitutive relationships of the true molecular volumes, is the constant b of the van der Waals's equation as calculated from the critical pressure and temperature by the equation $b_c=RT_c/8p_c$. The data, such as the molecular cross-section, obtainable from the viscosity coefficient of gaseous substances also furnish a trustworthy relationship between molecular volume and molecular structure. The data furnished by the above-named two methods are in complete agreement. Molecular refraction is just as unsuited as a basis for generalisations on the true molecular volume as is the volume at the boiling point. It is shown that in their dependence on the constitution of the molecule the true molecular volume and the apparent molecular volume are frequently diametrically opposed. J. F. S.

Negative Adsorption of Alkali Haloids by Wood Charcoal. ALWYN PICKLES (T., 1921, **119**, 1278—1280).

Chemical Reactions in Mixtures of Sols. H. FREUNDLICH and ALEXANDER NATHANSOHN (*Kolloid Zeitsch.*, 1921, **29**, 16—19).—A number of chemical reactions between similarly charged sols are described. These reactions in all probability occur between the micellæ directly. Sulphur sol prepared by Odin's method reacts

with silver sol prepared by the Carey Lea method to form silver sulphide sol, whilst arsenic trisulphide sol and silver sol react to form a silver-arsenic-sulphur compound the composition of which has not been determined. Silver sol and selenium sol react to form a sulphur-selenium sol. In the reaction between silver sol and sulphur sol a series of colour changes is passed through: brown, wine-red, violet, steel-blue, greenish-blue, greenish-brown, and finally a pale yellowish-brown. The colour changes are probably due, as in the case of the photo-chlorides, to micellæ with a varying content of silver, sulphur, and sulphide. A similar series of colour changes is observed in the reaction between arsenic trisulphide and silver sols. J. F. S.

Flocculation of Colloidal Arsenic Sulphide. Influence of the Dilution of the Electrolyte and of the Quantity of Electrolyte. A. BOUTARIC and M. VUILLAUME (*Compt. rend.*, 1921, **173**, 229—232; cf. this vol., ii, 449).—Using a constant quantity of electrolyte and colloid the velocity of flocculation diminishes at first as the dilution of the electrolyte increases, but tends towards a limit when the dilution of the electrolyte reaches a certain value. Thus in comparing the velocities of flocculation by different electrolytes, it is necessary to ensure that in every case the electrolyte is sufficiently diluted to realise the limit curve. When the amount of electrolyte is varied but the concentration is kept constant, the velocity of flocculation increases with the amount of electrolyte used. W. G.

Protecting Colloids. X. Saponin as Protecting Colloid. I. General Colloid-chemical Investigation on Guaiacum-Saponin and Quillaia-Saponin. A. GUTBIER, J. HUBER, and R. HAUG (*Kolloid Zeitsch.*, 1921, **29**, 19—25).—Saponin solutions when submitted to dialysis slowly pass through the parchment wall whilst at the same time an inorganic constituent slowly decreases in the residue. Ageing experiments show that the more dilute the solution, the more stable it is; thus a 1% solution deposits a small, flocculent precipitate in three days and is completely coagulated in four weeks, whilst a 0·25% solution is very stable. Viscosity experiments show that only after long keeping does the solution become more viscous, and then only very slightly. Solutions of saponin in dilute alcohol are also shown by viscosity measurements to be very stable. The viscosity of saponin solutions from 0·25% downwards is practically the same, but for stronger solutions the viscosity increases with the concentration. Heating a solution of saponin and then measuring the viscosity at the same temperature shows that the viscosity decreases regularly with increase of temperature. Boiling the solution for varying lengths of time up to twenty-four hours and then keeping it at 25° and measuring the viscosity at this temperature shows a slight decrease of viscosity followed by a slight increase with increasing amount of boiling. The addition of electrolytes, hydrochloric acid, sodium chloride, and sodium hydroxide, of various concentrations, produces no very fundamental change in solutions of saponin. J. F. S.

Protecting Colloids. X. Saponin as Protecting Colloid. II. Colloidal Gold. A. GUTBIER, J. HUBER, and R. HAUG (*Kolloid Zeitsch.*, 1921, **29**, 25—27; cf. preceding abstract).—The value of saponin as a protecting colloid has been examined in the case of gold sols. From previous work it appears that saponin should constitute an active protector in the case of suspensoids; it is shown in the present work that this is not always the case. The great tendency of saponin solutions to foam is the cause of the failure, for the colloid contained in the foam is found, after a very short interval, to have become entirely irreversible. In general, solutions of colloids in the presence of saponin are not precipitated by alcohol, but in the present case concentrated alcohol precipitates the gold and saponin as a jelly. From the various solutions examined it has been possible to obtain precipitates, some of which are reversible, containing from 2·2% to 30·77% of gold. J. F. S.

Coagulation of Dispersoid Solutions at the Interfaces of Phases. (Method of Separation into Layers and Method of Shaking.) A. YANEK (*Ann. école mines Oural*, 1919, **1**, 45—58).—Two methods were used for coagulating dispersoid solutions at the interfaces of two liquid phases: (1) by shaking them with immiscible organic solvents (benzene, chloroform, ethyl ether, and carbon disulphide) in sealed test-tubes, and (2) by pouring them into a homogeneous transparent mixture of 1 vol. of chloroform, 3 vols. of water, and 4 vols. of alcohol, or 3 vols. of benzene, 1 vol. of water, and 6 vols. of alcohol. In (2) the addition of certain dispersoid solutions at once causes the transparent mixture to become turbid like an emulsion The degree of dispersion of the latter then gradually diminishes, until finally the homogeneous mixture separates into two layers, at the interface of which the dispersoid phase is deposited as a thin film or in the form of fine flakes. It is found that negative dispersoid solutions of auric sulphide (obtained by passing hydrogen sulphide into a solution of auric chloride), zinc sulphide (obtained by passing hydrogen sulphide into a suspension of zinc hydroxide), and cupric sulphide (similarly obtained from a suspension of the precipitate produced by ammonium hydroxide in a solution of cupric sulphate) quickly and completely coagulate by both methods. The negative dispersoid solution of gold (obtained by reducing auric chloride with phenylhydrazine) coagulates but slowly when shaken with benzene, and still more slowly when shaken with ethyl ether, but quickly and completely when shaken with carbon disulphide or chloroform, and by the second method. The positive dispersoid solutions of ferric hydroxide (obtained by slowly heating a solution of ferric chloride hexahydrate to 80°) and aluminium hydroxide do not coagulate by either method. The second method was also applied to mixtures of mutually precipitating dispersoid solutions of gold (obtained by precipitating auric chloride with tannin) and ferric hydroxide.

It was found that there is an inverse ratio between the length

of time these mixtures are capable of existing and the degree of completeness of coagulation (this degree being measured by the ratio of the amount of coagulum to the total amount of the dispersoid phase) and also an inverse ratio between the completeness of coagulation and the length of time required to complete the process. Hence there is a direct ratio between the "life" of these mixtures and the duration of the coagulation process. The "longevities" of these mixtures and the velocities of coagulation are given in tables. The coagulation by the second, and probably also by the first, method is fractional. When a washed finger is immersed in the dispersoid solution of ferric hydroxide the latter behaves like a negative dispersoid solution both in (1) (shaken with chloroform) and (2). The same takes place when (1) is carried out not in sealed tubes, but in tubes closed with a washed finger. CHEMICAL ABSTRACTS.

Flame as Example of a Stationary Dispersoid System. P. P. VON WEIMARN (*Ann. école mines Oural*, 1919, **1**, Part 2, 5—6). —A flame represents a "stationary" not "stable" dispersoid system because in a stable system the particles do not change, whilst in a flame they constantly disappear, but are constantly renewed. The deposition of soot is likened to the coagulation of colloidal flakes, both being due to a concentration of particles exceeding the concentration which corresponds with the stationary state. The luminosity of a flame is most probably a function of the degree of dispersion of the dispersoid part of the stationary system. Whether the maximum of the former corresponds with the maximum of the latter is an experimental problem.

CHEMICAL ABSTRACTS.

The Equilibrium, Hydrofluoric Acid–Sulphuric Acid–Fluorosulphonic Acid. WILHELM TRAUBE and EMIL REUBKE (*Ber.*, 1921, **54**, [*B*], 1618—1626).—In previous communications (A., 1913, ii, 947; 1919, ii, 364) the unexpected stability of fluorosulphonic acid in the presence of water has been emphasised. It is now shown that equilibrium exists between sulphuric and hydrofluoric acids on the one hand and fluorosulphonic acid and water on the other in not too dilute aqueous solution. Reaction can only be partly represented by the scheme $H_2SO_4+HF \rightleftharpoons H\cdot SO_3F+H_2O$; a fuller account of the causes of the discrepancies is promised for a subsequent communication.

The formation of fluorosulphonic acid from hydrofluoric acid (62%) and sulphuric acid (94%) is readily demonstrated by treating the mixed acids with an excess of barium hydroxide, filtering, and treating the filtrate with acetic acid and nitron acetate, whereupon *nitron fluorosulphonate*, pale green needles, m. p. 225°, is precipitated.

The rate of decomposition of fluorosulphonic acid by water is estimated by agitation of a solution of the acid in nitrobenzene with water, filtration of aliquot portions of the solution after definite intervals of time, and precipitation of barium fluoride and sulphate in the alkaline filtrate; after removal of the precipitate, the filtrate

is acidified with hydrochloric acid and boiled, and the barium sulphate which is thereby precipitated is weighed. The total acid present in the solution is simultaneously estimated. Under these conditions and at atmospheric temperature, fluorosulphonic acid is found to be completely but very slowly hydrolysed. In this manner, it is only possible to work with small concentrations. In order to obtain more concentrated solutions and to avoid loss of hydrogen fluoride due to the heat evolved by mixing the components, fluorosulphonic acid, cooled to −20°, is very cautiously treated with similarly cooled ice; in these circumstances complete hydrolysis is avoided and the establishment of an equilibrium is definitely proved.

The course of the reaction can also be followed by titration with alkali since the formation of fluorosulphonic acid in accordance with the scheme $H_2SO_4+HF=H{\cdot}SO_3F+H_2O$ takes place with diminution of the acid titre. H. W.

Simultaneous Reactions of the Same Probability. F. E. C. SCHEFFER (*Rec. trav. chim.*, 1921, **40**, 477—487).—When a reaction is effected in *n* degrees and for each degree the transformation affects identical atoms or groups of atoms in identical conditions, the concentrations of the original substance and of the products of transformation successively formed are to one another as the terms of a binomial series of the *n*th degree. The product of the concentrations of the initial and final substances is equal to the product of the concentrations of the intermediate substances.

W. G.

The Nitration of the Phenyl Carbonates. (MLLE) J. M. A. HOEFLAKE (*Rec. trav. chim.*, 1921, **40**, 488—518).—The ternary melting-point diagram of the three isomeric nitrophenyl carbonates is given, and it is shown that in the presence of a trace of alkali as a catalyst an equilibrium is set up in the molten material conforming to the equation $2{\cdot}o:p \rightleftharpoons o:o+p:p$, the letters indicating the positions of the nitro-groups. Based on the ternary diagram and a binary curve of fusion for the *o* : *o*- and *p* : *p*-isomerides, the author has devised a method of analysis of the products of nitration of phenyl carbonate. From the results obtained it is shown that this reaction satisfies, as a first approximation, Scheffer's formula (preceding abstract). It follows that the two phenyl groups in the carbonate do not influence the reactions of one another. This was confirmed by a study of the nitration of the mononitrophenyl carbonates. W. G.

Studies on Hypophosphorous Acid. III. Its Reaction with Mercuric Chloride. ALEC DUNCAN MITCHELL (T., 1921, **119**, 1266—1277).

Mutual Reaction of Oxalic Acid and Iodic Acid. III. Influence of Bright Sunlight. GEORGES LEMOINE (*Compt. rend.*, 1921, **173**, 192—197; cf. this vol., ii, 100, 500).—Sunlight accelerates the interaction of oxalic and iodic acids. For a given temperature the time of half decomposition in sunlight

is only about 0·4 times that in darkness. The same velocity of decomposition is obtained in sunlight at a temperature 7° lower than that in darkness. W. G.

The Rôle of the Activity Coefficient of the Hydrogen-ion in the Hydrolysis of Gelatin. JOHN H. NORTHROP (*J. Gen. Physiol.*, 1921, **3**, 715—743).—When the hydrogen-ion concentration is kept constant, the hydrolysis of gelatin proceeds during the first part of the reaction according to the formula of a unimolecular reaction. This is most probably due to the fact that the simpler products of decomposition are more resistant to hydrolysis than gelatin itself. When, however, the hydrogen-ion concentration is not kept constant, the amount of hydrolysis in certain ranges of acidity is proportional to the square root of the time (Schütz's rule). The velocity of hydrolysis is independent of the gelatin concentration and is a function of the hydrogen-ion concentration, but not of the total amount of acid present. It is directly proportional to the hydrogen-ion concentration as determined by the hydrogen electrode. Neutral salts which increase the hydrogen-ion concentration also increase the velocity of hydrolysis to approximately the same extent. Between $P_H 2$ and $P_H 10$ the velocity of hydrolysis is almost constant and is very much greater than would be expected from the concentration of the respective ions. In strongly alkaline solutions the rate of hydrolysis is directly proportional to the hydroxyl-ion concentration. S. S. Z.

Catalytic Reduction of Ethylene to Ethane. DOROTHY MURIEL PALMER and WILLIAM GEORGE PALMER (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 402—412).—The rate of combination of hydrogen and ethylene in the presence of finely divided nickel has been measured at temperatures from 73° to 119°. The catalyst was deposited on clay balls which were caused to roll backwards and forwards in the reaction mixture. The method of measurement was static, the rate of reaction being deduced from the rate at which the gas mixture had to be added to keep the pressure constant. The curves showing the change of reaction velocity with time indicate an induction period, varying from a few seconds to three hours, during which there is practically no reduction. This is followed by a very rapid increase in reaction velocity to a sharp maximum, and finally the velocity falls away rapidly to a nearly steady value. The shape of the velocity–time curves is explained on the following hypothesis. Hydrogen is selectively adsorbed on nickel from mixtures of all the compositions studied whilst ethylene is adsorbed only after activation (chiefly by thermal contact with a molecule undergoing hydrogenation). On bringing the gas mixture into contact with the nickel, this becomes at once covered almost completely with hydrogen, only a few ethylene molecules being present in the adsorption layer; reaction with the formation of ethane takes place with these and the adsorbed hydrogen. The heat liberated in the hydrogenation is at once communicated to the molecules surrounding the hydrogenated molecule, leading to volatilisation of hydrogen and activation followed by

condensation of ethylene. The relative amounts of hydrogen and ethylene adhering to the surface of the catalyst thus change rapidly, once a number of centres of reaction have developed. The induction period is reduced in a very marked way either by increase of the ethylene content in the gas mixture or by increase in temperature, whilst the rate of reaction after the maximum has been passed is only very slightly affected by temperature. J. F. S.

The Influencing of Catalysts and Specifically Active Catalysts. E. ABEL (*Ber.*, 1921, **54**, [*B*], 1407—1409).—A criticism of some of the theories advanced by Rosenmund and Zetzsche (this vol., ii, 320, 392, 393). H. W.

Catalytic Activity of Copper. II. WILLIAM GEORGE PALMER (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 412—425; cf. A., 1920, ii, 609).—A continuation of previous work. In the present work the activity of copper, prepared at temperatures from 251° to 156°, on the decomposition of anhydrous ethyl alcohol and *iso*propyl alcohol containing 12% of water has been investigated. The copper catalyst was prepared by the reduction of copper oxide by carbon monoxide and by the vapour of methyl alcohol respectively. The results show that the activity of the catalyst does not necessarily increase continuously as the temperature of preparation from the oxide is lowered. The order of activity of the catalyst, reduced at various temperatures, is (*a*) carbon monoxide reduction, 215°, 229°, 194°, 243°; (*b*) methyl alcohol reduction, 251°, 225°, 217°. This result conflicts with the view that the real catalytic agent is an oxide of copper dissolved in reduced copper, but it can be readily reconciled with the hypothesis previously advanced (*loc. cit.*), namely, that the metallic copper produced by the reduction of cuprous oxide is the active agent. J. F. S.

Relation between the Occlusive Power of Palladium for Hydrogen and its Activity for Catalytic Hydrogenation. EDWARD BRADFORD MAXTED (T., 1921, **119**, 1280—1284).

The Velocity of Reaction in Hydrogenations by Platinum Black. G. VAVON (*Compt. rend.*, 1921, **173**, 360—362).—From a study of the velocity of hydrogenation of various mixtures of two substances it is shown that the part played by the solvent is important and that the rapidity with which the substance formed is removed from the catalyst has an important influence on the velocity of reaction. W. G.

Variations Produced by Stabilisers in the Catalytic Power of Electrosols of Platinum. A. DE GREGORIO ROCASOLANO (*Compt. rend.*, 1921, **173**, 234—236; cf. this vol., ii, 498).—In continuation of previous work (*loc. cit.*) it is shown that the presence of stabilisers causes a diminution in the catalytic power of electrosols of platinum. In the case of sodium protalbate, however, when the amount of stabiliser added was increased a point was reached at which the catalytic power also increased, but this was really a secondary effect due to the strongly alkaline reaction of this stabiliser. W. G.

Stability Relationships of Platinum-Organo-Sols. JOHS. LINDEMAN and THE SVEDBERG (*Kolloid Zeitsch.*, 1921, **29**, 1—16; cf. A., 1907, ii, 535; 1908, ii, 364).—The stability and size of the particles of platinum sols in ethyl ether, ethyl alcohol, and mixtures of the two have been investigated. It is shown that platinum amicrons may be gilded when the dispersion medium is ethyl alcohol or a mixture of ethyl alcohol and ethyl ether. The average radius of the amicrons can then be determined if the radius of the gilded particles is ascertained by sedimentation. Should the dispersion medium contain ether, the sedimentation must be carried out in closed vessels, for the evaporation of the ether hinders the process. The stability relations of the platinum sols in ether–alcohol mixtures have been examined by experiments on the size of the particles and by observations on the coagulation temperature. It is shown that these sols are never quite stable, but always tend, generally spontaneously, to complete coagulation. The age of these sols is determinative of their characteristics. The temperature, platinum concentration, and ether concentration appear to influence independently of one another the migration of the particles, in the sense that the velocity increases when one or more of these factors increases. The conception "Critical Temperature" of such a sol cannot be maintained in its original form, since it gives no upper temperature limit for the existence of the sols. The coagulation temperature depends much more on the velocity with which the temperature of a sol must be raised. It is preferable, therefore, to speak of the "critical curve" of a sol. J. F. S.

The Energetic Foundations of the Atomic Theory. G. URBAIN (*Bull. Soc. chim. Belg.*, 1921, **30**, 185).—A lecture delivered before the Belgian Chemical Society on June 26th, 1921.

A. A. E.

Periodic Table. A Modification more in accord with Atomic Structure. IVAN D. MARGARY (*Phil. Mag.*, 1921, [vi], **42**, 287—288).—The inert gases of the helium group are placed at the end of the series instead of at the beginning. J. R. P.

Latent Polarities of Atoms and Mechanism of Reaction, with Special Reference to Carbonyl Compounds. ARTHUR LAPWORTH (*Mem. Manchester Phil. Soc.*, 1920, **64**, (iii), 1—16).—A group such as NH_2 which tends to lower the acidity of a molecule is called "basylous"; one such as $CH_3{\cdot}CO$, which has the opposite effect, is called "acylous." The groups NH_2, NHAlk, etc., are basylous, but almost invariably exhibit negative polarity when attached to carbon; H is basylous and usually positive; CO, SO_3H, and NO_2 are strongly acylous and usually positive; whilst OH, OAlk, etc., are acylous and negative. Halogens are acylous and normally negative, but positive when contrasted with OH or NH_2. Compounds containing positive acylous groups yield acids by union with negative hydroxyl (for example, $CH_3{\cdot}CO$), and those with negative basylous groups (for example, NH_2) yield bases with positive hydrogen (or $\overset{+}{H}+H_2O$). Atoms in reactive

molecules may be labelled with + or — signs, although these are not intended to denote electrical charges, but merely indicate the relative polar characters which the two atoms seem to display at the instant of chemical change. Thus, the addition of electrolytes to the carbonyl group invariably proceeds as if the carbon atom were more positive than the oxygen atom, and selected the negative ion:

$$>\overset{+}{C}\!:\!\overset{-}{O}+\overset{-}{C}N\cdot\overset{+}{H}\longrightarrow\ >C(CN)-OH.$$

The aldol reaction, in which compounds containing the groups $>CH\cdot CO-$, $>CH\cdot NO_2$, $>CH\cdot CN$, etc., replace HCN above, suggests an enhanced positive polar character of the hydrogen atom relative to the carbon atom on which it is situated; this is indicated as follows:

$$\begin{array}{l}\ \ \ \overset{+}{H}\\ \ \ \ \ |\\ >C-C=O\end{array}$$

Evidence for the existence of latent polarisation in the two carbon atoms is adduced. The carbonyl group, therefore, tends to develop alternate — and + polarities in a chain of atoms. The order of alternating latent polarities is determined by the oxygen atom or atoms; in nitriles by the nitrogen atom. The "key-atom" is indicated by the addition of a dot to the sign of polarity:

$$\underset{+}{C}-\underset{-}{C}-\underset{+}{C}=\underset{\underset{\bullet}{-}}{O}\qquad \underset{+}{C}-\underset{-}{C}-\underset{+}{N}\equiv\underset{\underset{\bullet}{-}}{O_2}$$

$$\underset{+}{C}-\underset{-}{C}-\underset{+}{S}\equiv\underset{\underset{\bullet}{-}}{O_2}\qquad \underset{+}{C}-\underset{-}{C}-\underset{+}{C}\equiv\underset{\underset{\bullet}{-}}{N}$$

Bivalent oxygen and tervalent nitrogen (negative) are much more effective in producing such alternations of polarity than halogens, and the influence of the oxygen is usually greater than that of the nitrogen. A perceptible influence of the opposite kind seems to be exercised by hydrogen; carbon and quinquevalent nitrogen appear to be nearly indifferent. The extension of the influence of the key-atoms over a long range requires for its fullest display the presence of double bonds, usually in conjugated positions. The above rule is called the "principle of induced alternate polarities."

Markownikoff's rule is readily explained:

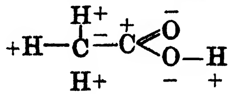
$$\overset{-}{X_1}\cdot\overset{+}{Y_1}+\underset{-}{C}=\underset{+}{C}-\underset{\underset{\bullet}{-}}{X}\longrightarrow \overset{+}{Y_1}-\underset{-}{C}-\underset{+}{C}<^{\overset{-}{X_1}}_{\underset{-}{X}}$$

$$\overset{-}{X_1}\cdot\overset{+}{Y_1}+\underset{+}{C}=\underset{-}{C}-\underset{\underset{\bullet}{+}}{Y}\longrightarrow \overset{-}{X_1}-\underset{+}{C}-\underset{-}{C}<^{\overset{+}{Y_1}}_{\underset{+}{Y}}$$

Heterogeneous arrangements arise when two isodynamic phases of the molecule can be induced by different key-atoms:

$$(A)\ \underset{\underset{\bullet}{+}}{H}-\underset{-}{C}<^{O}_{\underset{+}{O}-H}\qquad (B)\ \underset{-}{H}-\underset{+}{C}<^{O}_{\underset{-}{O}-\underset{+}{H}}$$

In *homogeneous* arrangements the effect is the same no matter which of the oxygen or hydrogen atoms is regarded as the key-atom (for example, acetic acid; ethyl acetoacetate):



Halogens in the α-position behave as positive, those in the β-position as negative, groups. The relative acidities of the three isomeric cresols is explained. The principle of induced alternate polarities is considered in conjunction with free, partial, and latent valencies, and conjugation. Reference must be made to the original for schemes of reaction illustrating the application of these principles. J. R. P.

The Conjugation of Partial Valencies. ROBERT ROBINSON (*Mem. Manchester Phil. Soc.*, 1920, **64**, (4), 1—14).—The hypothesis previously described (T., 1916, **109**, 1029, 1039; 1917, **111**, 958; 1918, **113**, 639; 1919, **115**, 943) is applied to various types of chemical reactions of carbon compounds. J. R. P.

Universality of any Given State as a Consequence of the Fundamental Law of Energetics. P. P. VON WEIMARN (*Ann. école mines Oural Institute,* 1919, **1**, Part 2, 1—3).—Accepting Ostwald's view that matter is merely a spatial aggregation of different varieties of energy, and in view of the fundamental law that these varieties are mutually convertible, the author draws the conclusion that it ought to be possible to convert the chemical elements into one another, the problem reducing itself to finding the conditions for realisation of any given state. Thus, under the sodium state all elements should change to sodium; under the gold state they should change to gold, etc. CHEMICAL ABSTRACTS.

A Rotary Burner. W. VON HEYGENDORFF (*Zeitsch. angew. Chem.*, 1921, **34**, 359—360; cf. Lockemann, this vol., ii, 447).—The burner consists of a hollow drum mounted on the leading-in tube for the gas as a pivot. The top surface of the drum is provided with six holes closed by screw plugs and arranged spirally. According to the size and shape of the vessel to be heated, any number of these plugs are replaced by bunsen or other suitable burners. The lower half of the drum is filled with glycerol, which acts as a liquid seal during the rotation, which is effected by means of a small motor and a driving wheel, affixed to the lower stem of the drum. A. R. P.

Inorganic Chemistry.

New Revision of the Density of Oxygen Gas. E. Moles and F. Gonzalez (*Compt. rend.*, 1921, **173**, 355—358).—The oxygen used was prepared from potassium permanganate, potassium chlorate, mercuric oxide, or silver oxide, or electrolytically; and the mean of forty-five determinations gave the value 1·42889 as the density of oxygen at 0° and 760 mm. W. G.

The System, Bromine–Tellurium. The Nature of Tellurium Sub-bromide. A. Damiens (*Compt. rend.*, 1921, **173**, 300—303).—Using the physico-chemical methods previously applied to the system, iodine–tellurium (this vol., ii, 110, 257), it is shown that tellurium sub-bromide, $TeBr_2$, exists in the gaseous state, but is unstable in the solid state. It is an endothermic substance starting from tellurium and its tetrabromide. W. G.

Apparatus for the Preparation of Small Quantities of Pure Nitrogen or Carbon Monoxide. H. P. Waran (*Phil. Mag.*, 1921, [vi], **42**, 246—249).—An arrangement is described for dropping one liquid into another for the generation of a gas. Nitrogen is prepared by dropping bromine water into ammonia, and carbon monoxide by dropping formic acid into concentrated sulphuric acid, both gases being dried by phosphoric oxide.
J. R. P.

The Rôle of Gaseous Impurities in the Catalytic Oxidation of Ammonia. Eugène Decarrière (*Compt. rend.*, 1921, **173**, 148—151; cf. this vol., ii, 503).—Acetylene in small amounts in the gaseous mixture causes a slight rise in the yield during the first few minutes in the catalytic oxidation of ammonia, but this is speedily followed by a drop in the yield. This drop in the yield is proportional to the absolute amount of the impurity which has passed rather than to its actual proportion, and continues even when the proportion passing is decreased or removed. The presence of hydrogen sulphide along with the acetylene in the proportion of 1 : 9 by volume apparently neutralises the influence of the acetylene alone. The initial rise is obtained, but there is no appreciable diminution in the yield. W. G.

Glow of Phosphorus. Periodic Luminosity, and Action of Inhibiting Substances. Lord Rayleigh (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 372—384).—The intermittent or periodic luminosity observed in a gas space when the last traces of oxygen are being removed by means of phosphorus, or when air is allowed slowly to leak into an exhausted vessel containing phosphorus, has been investigated. It is shown that this effect, as ordinarily observed, requires the presence of water vapour. Moderate drying, for example by sulphuric acid, makes the glow perfectly steady. Water vapour has therefore the power of inhibiting the combination of phosphorus vapour and oxygen within certain limits. When the

composition of the mixture becomes favourable beyond those limits, a wave of combustion is propagated. Other substances are known to inhibit the glow of phosphorus, and some of these can be used to exhibit the above-named phenomena in a far more striking form than water. Among the substances examined are camphor, pear oil (mainly amyl acetate), turpentine, ammonia, oils of aniseed, lavender, peppermint, eucalyptus, and cinnamon, nitrobenzene, butyl alcohol, amyl nitrite, and oil of bitter almonds. Of these, camphor, ammonia, and pear oil are the most effective, and experiments with them are described in detail. It is shown that the propagation of the waves of combustion cannot be attributed to the rise of temperature of one layer igniting the next layer, for the rise of temperature is too small. An alternative hypothesis of the propagation is proposed, which assumes that it depends on the provision of nuclei, as in the propagation of crystallisation through a supercooled liquid. On the basis of this hypothesis, the action of inhibitors (negative catalysts) is considered and explained. J. F. S.

The Fixation of Carbon Monoxide Diluted and Carried Along by a Current of Air. Desgrez, Guillemard, and Hemmerdinger (*Compt. rend.*, 1921, **173**, 186—188).—The only satisfactory reagent found by the authors consisted of 70 grams of iodic anhydride, 18 c.c. of sulphuric acid (*d* 1·817), and 85 grams of granulated pumice. This mixture oxidised the whole of the carbon monoxide at a concentration of 8 parts per 1000 of air, the mixture passing at the rate of 7 litres per minute at a temperature of 35°. W. G.

Action of Sodium Amalgam on Carbon Tetrachloride. Bruno Fetkenheuer (*Zeitsch. anorg. Chem.*, 1921, **117**, 281—282).—On warming carbon tetrachloride with 1% sodium amalgam a vigorous reaction sets in, which, investigation shows, is to be represented by the equation $4Na + CCl_4 = 4NaCl + C$. The reaction is quantitative, and after the initial heating completes itself quantitatively without further heating. J. F. S.

Formation of Twins in the Surface Layers of Metals during Cold Working. Rudolf Vogel (*Zeitsch. anorg. Chem.*, 1921, **117**, 271—280).—It is shown that during the polishing or shearing of plastic metals and alloys, the surface is changed to a definite depth, a fact which must be taken into account when investigating the characteristic structure of metals. It is shown that on etching a section the appearance of a twin-hatching is not the characteristic of the unworked metal, but the property of a thin surface layer which has been subjected to a cold local working, and on warming the material, undergoes a recrystallisation and disappears. The formation of the twins is explained as follows: the particles of the polishing material cut furrows in the surface of the metal and the material thus removed is pushed to either side, where it is not in equilibrium with the general orientation of the mass, and therefore a recrystallisation occurs. J. F. S.

Crystal Structure of Silver Haloids. R. B. WILSEY (*Phil. Mag.*, 1921, [vi], **42**, 262—263).—The crystal structures of silver chloride, bromide, and iodide were determined by the powder method. Silver chloride and bromide each gave the pattern of a simple cube of sides 2·78 Å.U. and 2·89 Å.U., respectively. The density of the elementary cube shows that one atom is associated with each point of the cubic lattice. Silver iodide gave the diffraction pattern of the diamond lattice, in which each side of the elementary cube was 6·53 Å.U.; one atom is to be ascribed to each point in the structure. Each iodine atom is at the centre of a tetrahedron the corners of which are occupied by four silver atoms, and each silver atom is surrounded by four iodine atoms in the same manner, the distance apart of the nearest atomic centres being 2·83 Å.U. The precipitated haloids were used; the flocculent precipitates are thus shown to be crystalline. Powdered fused silver bromide gave the same pattern as the precipitated salt. J. R. P.

The Highest Oxides of Calcium and Barium. WILHELM TRAUBE and WALTER SCHULZE (*Ber.*, 1921, **54**, [*B*], 1626—1644).—The formation of yellow products by the treatment of alkaline-earth peroxides with hydrogen peroxide has been fairly frequently recorded in the literature, but the substances have not hitherto been subjected to an extended examination. Evidence is now brought forward which points to the existence of tetroxides of calcium and barium, the former of which is considerably the more stable.

The preparation of the calcium compound is usually effected by gently warming calcium peroxide octahydrate with five to six times its quantity of pure hydrogen peroxide (30%) until a vigorous evolution of oxygen occurs; the product is removed from the source of heat until the evolution of gas subsides and the warming and cooling are repeated until practically no more gas is evolved. The precipitate is washed successively with water, alcohol, and ether and dried. The preparations have a bright yellow colour and can be heated at 130° without change in this or other property. They all show the property of dissolving in acid with a more or less brisk evolution of gas and the natural production of hydrogen peroxide; the gas consists of oxygen mixed with small amounts of carbon dioxide. The quantity of the former in the best preparations amounts to 2·7% of the weight of the substance. The evolution of oxygen is a primary action and not dependent on the decomposition of liberated hydrogen peroxide, since it occurs under conditions which do not cause evolution of gas from calcium peroxide octahydrate if it has not assumed a yellow colour. The evolved oxygen is inactive, since bromine is not liberated when the evolution takes place in an acidified solution of potassium bromide and iodine is only slightly displaced from acidified potassium iodide solution. The only known types of substance which evolve inactive oxygen are the oxyhydroxides, for example, $(KOH)_2O_2$, and the tetroxides, for example, K_2O_4. The stability of the present substance towards heat excludes the first method

of formulation, so that it is to be regarded as calcium tetroxide, CaO_4; as judged by the amount of oxygen evolved, this substance is present to the maximum extent of 8·7% in the various preparations. A typical specimen contained calcium tetroxide (5·96%), calcium peroxide (88·38%), calcium carbonate (1·98%), calcium hydroxide (2·87%), water (0·66%).

The formation of calcium tetroxide occurs, but to a considerably less extent, when calcium peroxide octahydrate is treated with water alone at 100°, its production depending on the reaction $CaO_2+2H_2O \rightleftharpoons Ca(OH)_2+H_2O_2$. Its presence also accounts for the faint yellow coloration of specimens of calcium peroxide octahydrate which have been dried at 100° or in a vacuum at 0°; an almost colourless substance can be secured only when desiccation is effected at 0° in a non-exhausted desiccator over sulphuric acid, and it is remarkable that such specimens are not transformed into the tetroxide by treatment with hydrogen peroxide.

Barium tetroxide is much less stable than the calcium compound. The substance, BaO_2,H_2O_2, can only be preserved (and even then not for extended periods) at temperatures below 0°. At the atmospheric temperature it speedily becomes yellow owing to formation of the tetroxide, and the colour increases in intensity during twenty-four to thirty-six hours, after which it disappears almost completely within four or five days, reaction proceeding according to the scheme $2BaO_2,H_2O_2=2BaO_2,H_2O+O_2$. The process occurs much more rapidly at 50—60°. If the highly coloured preparations are dissolved in acid, inactive oxygen is evolved, the amount of which corresponds with the presence of about 8% of barium tetroxide in the best preparations. The faintly coloured final products can be heated at 100° without losing the last traces of colour, which loss, however, occurs at a higher temperature with formation of anhydrous barium peroxide. The impossibility of isolating purer specimens of barium and calcium tetroxide by the present method is caused by the ready decomposability of the products in the presence of water.

The formation of the tetroxides also takes place when the peroxides, either moistened with hydrogen peroxide or in the form of their hydrates, are exposed to ultra-violet rays. H. W.

The Preparation of Calcium Carbide from Calcium Ammonium and Acetylene. L. HACKSPILL and E. BOTOLFSEN (*Compt. rend.*, 1921, **173**, 151—153).—The method of preparing calcium carbide by the action of acetylene on calcium ammonium, the product being subsequently heated to 150°, as described by Moissan (*Compt. rend.*, 1898, **127**, 911), does not give pure calcium carbide. The product when decomposed by water gave a gas containing 25% of hydrogen and 4% of ammonia, or when heated from 150—500° gave a gas containing 5% of ammonia, 20% of acetylene, and 75% of hydrogen. W. G.

Crystalline Characters of Calcium Carbide. C. H. WARREN (*Amer. J. Sci.*, 1921, [v], **3**, 120—128).—Calcium carbide reveals cleavage surfaces, the cleavages being nearly equal, and parallel

to three directions at right angles to one another. The examination of cleavage fragments indicates that the carbide contains thin lamellæ which are either parallel, or inclined at 45°, to the cleavage edges. The whole structure of calcium carbide is very complex. It is considered to be of orthorhombic symmetry with a polysynthetic twinning parallel to the diagonals at 45° to the pinacoids (pseudo-duodecahedral). The twinning is mimetic, causing the carbide to appear pseudo-cubic geometrically, and pseudo-tetragonal optically. W. J. W.

Reaction of Calcium Phosphate with Sodium Carbonate and Sodium Hydrogen Carbonate. JOH. PINNOW (*Zeitsch. Elektrochem.*, 1921, **27**, 309—319).—The reaction between calcium phosphate and sodium carbonate and sodium hydrogen carbonate respectively has been examined quantitatively at 100°. It is shown that the reactions between calcium hydrogen phosphate ($CaHPO_4,2H_2O$) with sodium carbonate and disodium hydrogen phosphate in the presence of a sufficient excess of base proceed further than the formation of normal sodium phosphate when carbon dioxide is removed by passing a brisk stream of steam through the mixture. In this case, a quaternary phosphate appears in the solid phase. The quantity of carbon dioxide expelled increases, in general, with the dilution in consequence of the increased hydrolysis of the sodium carbonate. From the composition of the solutions it is shown that with a constant relationship between the components of the reaction the normal sodium phosphate content of the solid phase increases with increasing concentration, and also a portion of the sodium salt may be removed by washing the solid phase. It would therefore seem to be impossible to prepare normal calcium phosphate and calcium hydrogen phosphate free from sodium in the presence of sodium salts. The phosphoric acid content of the solid phase and the solution influence only indirectly the carbonic acid content of the solution and solid phase. The phosphoric acid content of the solid phase varies between very narrow limits and does not fall below 30% after repeated treatments with saturated sodium carbonate solution, and the calcium carbonate content never exceeds 22%. A complete separation of phosphoric acid and calcium by boiling with sodium carbonate solution is therefore impossible. J. F. S.

The Metallurgy of Zinc. LEMARCHANDS (*Rev. Metall.*, 1920, **17**, 803—811. See also A., 1920, ii, 313).—Experimental investigations of the action of carbon on zinc oxide in an atmosphere of nitrogen, the action of carbon monoxide on zinc, and the action of carbon monoxide on zinc oxide lead to the following conclusions: (1) Zinc oxide is reduced by carbon and by carbon monoxide simultaneously. (2) The reduction of zinc oxide by carbon begins at temperatures which depend on the rate of heating, being lower for rapid heating. (3) The temperature of reduction of zinc oxide by carbon is governed by the reaction velocity of the heterogeneous

system ($ZnO+C$), that is by the rate at which the two substances can diffuse and thus come into contact with each other. (4) The temperature of reduction of zinc oxide by carbon is much lower than has been previously believed, as low as 762°. (5) The reaction $ZnO+C=Zn+CO$ is reversible. It proceeds from left to right at 600°, but only at much higher temperatures is the reverse reaction noted. (6) Zinc oxide is reduced by carbon monoxide much more easily than has previously been believed, even at temperatures as low as 350—400°. (7) Values calculated on the basis of the energy liberated in the formation of these substances agree well with those found experimentally. CHEMICAL ABSTRACTS.

The so-called Action of Water on Lead. JOHN C. THRESH (*Analyst*, 1921, **46**, 270—279).—Water itself has no action on lead and merely acts as an inert medium by means of which foreign substances dissolved in it may act on the metal. Dissolved oxygen combines with the lead to form a soluble oxide or hydroxide, which remains in solution (up to saturation) unless other substances capable of combining with it are present. This solution is of a colloidal nature, and of such a coarse degree of dispersion or so liable to adsorption that it will not pass through a Pasteur filter and may even be removed by a filter-paper of fine texture. In the presence of acids yielding soluble lead salts, such salts are formed and remain in solution, but with acids yielding insoluble salts a precipitate is formed which may be deposited on the metal in such a way as to prevent further action. Any soluble salts present in the water may also act on the lead hydroxide. The whole subject is dealt with under the following headings: Effect of filtration on lead in water; factors affecting the colorimetric estimation of lead; influence of heat and agitation on the solution of lead; influence of surface area; action of distilled water; rate of utilisation of oxygen; effect of carbon dioxide; influence of carbonates. In the colorimetric estimation of lead by means of hydrogen sulphide, the best results are obtained in acetic acid solution, especially with acetic acid containing gelatin. W. P. S.

The Interpenetration of Solids. H. WEISS and P. LAFITTE (*Compt. rend.*, 1921, **173**, 146—148).—In continuation of previous work (A., 1920, ii, 545) it is shown that in the interpenetration of zinc and copper there is no discontinuity for the penetration of zinc into copper at the melting point of zinc. This result is confirmed by experiments with tin and copper, and mercury and copper. Penetration occurs at temperatures considerably below the melting point of either of the metals if sufficient time is given.

There is very appreciable penetration of zinc or tin into copper at 100° during one month. Experiments, at temperatures in each case slightly below the minimum melting point for the couple, on couples with copper as one metal and a large range of metals for the other, gave a positive result in every case except when aluminium was the second metal, and even in this case lack of penetration was probably due to lack of contact between the two metals. W. G.

Sodium Cuprite. ERICH MÜLLER [with (FRL) ILSE ERNST] (*Zeitsch. angew. Chem.*, 1921, **34**, 371—373).—Both cupric hydroxide and oxide, when shaken with strong solutions of sodium hydroxide, dissolve to an amount depending on the concentration of the alkali. The maximum solubility is reached at about 15·8*N*-sodium hydroxide and is about 0·4 mole of copper per litre in the case of the hydroxide and 0·05 mole in the case of the black oxide. On increasing the concentration of the alkali, the solubility suddenly falls in both cases to the same figure, and in 18*N*-solutions there is practically no copper in solution. In solutions of lower concentration than 15*N*, the stable solid phase is black cupric oxide, whilst with solutions of higher concentration it is sodium cuprite, which appears as a blue precipitate similar in appearance to cupric hydroxide, which, however, on warming the solution in which it is produced and again allowing to cool, crystallises. The crystals cannot be washed free from excess of alkali as they decompose into the black oxide in contact with an excess of water. Equilibrium diagrams are given of the system, copper hydroxide–sodium cuprite–sodium hydroxide–copper oxide, and the subject is discussed from a physico-chemical point of view. A. R. P.

Purification of Mercury. C. HARRIES (*Zeitsch. angew. Chem.*, 1921, **34**, 359).—An efficient method for the purification of mercury, especially that containing lead or tin which cannot be removed by distillation or treatment with nitric or chromic acids, is to heat the metal for several hours at 150° in a large flask whilst passing a current of air through it by means of a glass tube extending about 1 cm. below the surface. The metal is continually agitated and, when a considerable scum of oxide has collected on the surface, it is filtered and again treated by the same method. The process is repeated until no further scum forms, after which the filtered metal is distilled in a vacuum from an ordinary fractionating flask provided with a cork stopper carrying the condensation apparatus. The stopper is rendered gas-tight by smearing it with a mixture of chalk and glue or sulphite cellulose tar. The oxide scum produced in the first stage of the purification may contain a certain amount of finely-divided mercury, which is recovered as metal by digestion of the scum with hydrochloric acid. A. R. P.

Combinations of Halogenated Derivatives of Mercury and of Thallium. J. BARLOT and J. PERNOT (*Compt. rend.*, 1921, **173**, 232—234).—Mercury and thallium form a double chloride, *bromide*, and *iodide* of the type HgX_2,TlX, where X represents the halogen. The thallium may be estimated in these salts by converting them into the mixed nitrates, precipitating the thallium and mercury as sulphides, dissolving out the thallium sulphide with 10% nitric acid, and finally precipitating and weighing the thallium as thallous iodide. W. G.

The Ternary System: Ammonium Chloride–Manganous Chloride–Water. FREDERICK WILLIAM JEFFREY CLENDINNEN and ALBERT CHERBURY DAVID RIVETT (T., 1921, **119**, 1329—1339).

Iron–Carbon Alloys. RUDOLF RUER (*Zeitsch. anorg. Chem.*, 1921, **117**, 249—261).—The temperature–composition diagram of the system : iron–carbon has been further investigated in connexion with the solubility of cementite in molten iron and the perlite equilibria corresponding with the complete equilibrium between austenite, ferrite, and graphite. Experiments are described which show that cementite exists undecomposed in the molten system. Experiments on isolated cementite show that decomposition with separation of graphite commences at temperatures just above 1100°, and that it is impossible to melt this substance without decomposition. The amount of decomposition of cementite is 6·0% at 1112° and 63% at 1132°, at these temperatures the mass is not molten, but melts completely at 1164°. Time–cooling and time–heating curves have been made with iron containing 5% of carbon. A halt is observed at 734° in the heating curve, and on cooling from 772° a halt occurs at 720°. After allowing to cool to 600° and then reheating, halts were observed at 736° and 746°, and on again cooling the same halt was obtained at 720°, which after several successive treatments became 718°. The results show that the perlite transition occurs at 721° (cf. this vol., ii, 198). Since on the heating curve the halt corresponding with the stable eutectic lies 12° higher than that corresponding with perlite (746° against 734°), so will also the equilibrium temperature of the stable eutectic lie 12° higher than the transition temperature of the perlite, that is, at 733°. J. F. S.

The Retarded Solution and Premature Precipitation of Cementite in Eutectic and Hypereutectic Carbon Steels. SAUVAGEOT (*Compt. rend.*, 1921, **173**, 297—300).—From work with tool steels the author confirms the results of Portevin and Chevenard (this vol., ii, 510). In steels which are totally or locally hypereutectoid the influence of the initial state of the cementite on the temperature at which it disappears is very important. W. G.

"Caput mortuum" again. EDMUND O. VON LIPPMANN (*Chem. Zeit.*, 1921, **45**, 801).—A brief historical essay on the origin of the terms "caput mortuum" and "colcothar." A. A. E.

Reaction between Iron Sulphide and Carbon Dioxide. V. M. GOLDSCHMIDT (*Tidskrift Kem.*, 1920, **17**, 215—218, 221—228).—The reaction expressed by the equation $FeS+3CO_2=FeO+3CO+SO_2$ does not take place below 630°, and a temperature of 1150° is necessary for appreciable reaction, whereas ferrous oxide is attacked by sulphur dioxide at 580°. Theoretical, as well as experimental, results demonstrate that the reaction is unlikely to possess practical value in metallurgical processes.
CHEMICAL ABSTRACTS.

Titanium. MAURICE BILLY (*Ann. Chim.*, 1921, [ix], **16**, 5—54).—A more detailed account of work already published (A., 1912, ii, 1178; 1914, ii, 281; this vol., ii, 456). W. G.

The Equilibria of Ter-, Quadri-, and Quinque-valent Vanadium in Solution in Concentrated Sulphuric Acid. V. AUGER (*Compt. rend.*, 1921, **173**, 306—308).—A solution of vanadic acid in sulphuric acid begins to decompose before the boiling point is reached. It loses oxygen, and after boiling for several hours an equilibrium is reached, two-thirds of the vanadium being reduced to the quadrivalent state, if the solution contains less than one part of vanadium per thousand. With more concentrated solutions, as soon as the reduction has commenced, vanadyl hydrogen sulphate is first deposited and then vanadyl sulphate until the concentration is reduced to 1 : 1000. In all cases, reduction is incomplete. Sulphur dioxide slowly reduces the vanadic–sulphuric acid solution. In the presence of sulphur, the reduction of quinquevalent vanadium gives at first a blue solution of the hypovanadyl salt and then at a later stage anhydrous vanadous sulphate is deposited and the solution is entirely free from vanadium.

Starting with a hypovanadic–sulphuric acid mixture as soon as the boiling point is reached, sulphur dioxide is liberated until one-third of the vanadium is oxidised and the solution contains the same volume of quadri- and quinque-valent vanadium as the solution mentioned above. W. G.

Mineralogical Chemistry.

The Origin and Chemical Structure of Coal. K. G. JONAS (*Zeitsch. angew. Chem.*, 1921, **34**, 373—374).—Polemical. The author considers that the theory of the origin of coal from the lignin and not from the cellulose portion of plants developed by Fischer and Schrader (this vol., ii, 210) is not in accordance with all the known facts, and in some cases even does not agree with their own results. A. R. P.

Formation of Fluorite at the Ordinary Temperature. W. WETZEL (*Centr. Min.*, 1921, 444—447).—Fragments of a calcareous rock (calcareous sandstone or siliceous limestone) were placed for some days in 3% hydrofluoric acid in a vulcanite vessel. The resulting small, model-like octahedra, up to 0·28 mm. across, have the characters of fluorite, except the low *d* 2·2 which is attributed to inclusions. By the action of the dilute acid on ordinary (soda-lime) glass minute octahedra are also produced, which only differ from fluorite in showing anomalous birefringence. L. J. S.

Analytical Chemistry.

Further Improvements in the Nephelometer-Colorimeter. PHILIP ADOLPH KOBER and ROBERT E. KLETT (*J. Biol. Chem.*, 1921, **47**, 19—25; cf. A., 1915, ii, 837; 1917, ii, 266).—The improvements, which are mainly designed to eliminate fatigue during the use of the instrument, are: the removal of the milled heads which operate the cups from the top to the bottom of the instrument; the provision of a 50 mm. auxiliary scale which can be read from the top of the instrument through an eye-piece of the same focal distance as the telescope; and the presence of a micrometer arrangement for setting the zero point which can be locked in any position. E. S.

The Substitution of Turbidimetry for Nephelometry in certain Biochemical Methods of Analysis. W. DENIS (*J. Biol. Chem.*, 1921, **47**, 27—31).—The author recommends the use of the turbidimeter (cf. Folin and Denis, A., 1914, ii, 687) in place of the nephelometer on the grounds that the former method gives accurate results with fairly wide differences (50%) between the strengths of the standard and unknown solutions. It was tested in the estimation of calcium in blood by Lyman's method (A., 1917, ii, 271), of fat in blood and milk by Bloor's method (A., 1914, ii, 392), and of inorganic phosphates in blood plasma (cf. Bloor, A., 1918, ii, 452). E. S.

Estimation of the Hydrogen-ion Concentration in Water by a Colorimetric Method. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 1005—1020).—In a colorimetric method the water is treated with neutral-red solution, and the tint is compared with standardised acid and alkaline solutions of the same indicator contained in two wedge-shaped tubes attached to each other by Canada balsam. By means of a movable graduated scale the value of p_H for the corresponding tint can then be read off directly. This method is preferable to the use of the hydrogen electrode. From a knowledge of the hydrogen-ion concentration and the bicarbonate content, the carbon dioxide content may be determined from $[CO_2]=[H^{\cdot}][HCO_3{}']/3\times10^{-7}$ (cf. this vol., ii, 409). W. J. W.

The Potentiometric Titration of Iodides by means of Permanganate. I. M. KOLTHOFF (*Rec. trav. chim.*, 1921, **40**, 532—538).—The author confirms Hendrixson's statement (this vol., ii, 411) that potassium iodide can be titrated potentiometrically with potassium permanganate in the presence of sulphuric acid. The results are very accurate even in dilute solutions, provided that the concentration of the acid is not less than $0{\cdot}13N$. The presence of bromides or chlorides considerably lowers the jump in potential at the end point, but iodide can be estimated in the presence of twice the equivalent amount of bromide or twenty times the equivalent amount of chloride. W. G.

Colorimetric Estimation of Sulphur in Cast-iron and Steel. G. Misson (*Ann. Chim. Analyt.*, 1921, [ii], **3**, 200—201).—One gram of the sample is placed in a conical flask, 10 c.c. of benzene and 50 c.c. of hydrochloric acid are added, and the mouth of the flask is covered with a piece of filter-paper moistened with arsenious acid solution (10 grams of arsenious oxide dissolved in 30 c.c. of concentrated hydrochloric acid and diluted to 1 litre); on this paper cover are placed, in order, a piece of white felt 5 mm. in thickness, an ebonite plate, and a lead plate weighing about 500 grams. The liberated hydrogen sulphide is absorbed by the impregnated filter-paper and the yellow coloration of the arsenious sulphide is distributed uniformly over the surface. The coloration obtained is compared with those obtained from standard specimens of metal containing known amounts of sulphur. W. P. S.

Rapid Estimation of Sulphur in Urine. Ch. Rabaut and A. Stillmunkés (*Progrès méd.*, 1920, 50—51; *Rep. pharm.*, 1921, (3), **33**, 37—38).—Sulphur as preformed sulphate is estimated volumetrically by addition of a standard acidified solution of barium chloride, the reaction tube being centrifuged after each addition, until precipitation no longer takes place. Total sulphate (preformed + conjugate) is estimated in a like manner after boiling the urine with hydrochloric acid, the total sulphur content being similarly estimated in a clear solution of the incinerated urine. Chemical Abstracts.

Estimation of Inorganic Sulphate, Total Sulphate, and Total Sulphur in Urine by the Benzidine Method. Cyrus H. Fiske (*J. Biol. Chem.*, 1921, **47**, 59—68).—An error, which is pronounced in the case of short period metabolism experiments, is introduced in the estimation of sulphates in urine by the benzidine method (A., 1914, ii, 142, 485; A., 1916, ii, 147) owing to the solubility of benzidine sulphate in the presence of chlorides. To avoid this error a modified method is described in which phosphates are first precipitated by shaking the diluted urine with finely powdered basic magnesium carbonate after making faintly alkaline to phenolphthalein with ammonia and adding a small quantity of ammonium chloride. The filtered solution is then used for the three estimations. Excess of chloride can now be avoided (1) in the case of the inorganic sulphate, by addition of only sufficient hydrochloric acid to make the liquid acid to bromophenol-blue; (2) in the case of the total sulphate, by hydrolysing by evaporation to dryness with a small quantity of hydrochloric acid; (3) in the case of the total sulphur, by removal of excess of hydrochloric acid, after dissolving the residue of copper oxide, by evaporation to dryness instead of by neutralisation. E. S.

New Method for the Estimation of Thiosulphate in the Presence of Sulphite and Tetrathionate. Albin Kurtenacker and Albert Fritsch (*Zeitsch. anorg. Chem.*, 1921, **117**, 262—266).—Thiosulphate may be estimated in the presence of sulphite by the following method. The mixture of the two salts is titrated in the

usual way by means of $N/10$-iodine solution; the solution is then diluted to 200 c.c., treated with phenolphthalein, and neutralised with 5% ammonia solution. The neutral solution is now treated with about 7 c.c. of 10% potassium cyanide solution and after keeping for ten to fifteen minutes the following reaction will have completed itself: $3KCN+Na_2S_4O_6+H_2O=Na_2S_2O_3+K_2SO_4+KCNS+2HCN$. The solution is acidified with 25—50 c.c. of sulphuric acid (1 : 3) and titrated with $N/10$—$N/20$-iodine solution. From the two titration values the amount of thiosulphate and sulphite may be calculated. The method gives trustworthy results, but the conditions mentioned must be strictly adhered to.

J. F. S.

Detection of Nitrogen in Organic Compounds. CONSTANTIN D. ZENGHELIS (*Comp. rend.*, 1921, **173**, 308—310).—The organic matter is mixed with a mixture of soda-lime and copper powder, the latter two being in the proportion of 2 : 1. The mixture is placed in a crucible and covered with a layer of soda-lime and copper powder. The crucible is covered with a watch glass carrying on its under-surface a drop of the formalin–silver nitrate reagent for the detection of ammonia (this vol., ii, 558) and on its upper-surface a drop of cold water. The crucible is heated on a quartz plate until drops of water begin to condense on the watch glass, when it is put on one side. The formation of a silver mirror indicates the presence of nitrogen in the organic compound. The method is very sensitive and requires but a very small amount of material, and is applicable to all types of organic nitrogenous compounds. W. G.

Gasometric Estimation of Nitrogen. RAYMOND L. STEHLE (*J. Biol. Chem.*, 1921, **47**, 11).—The liberation of oxygen in the gasometric estimation of nitrogen (this vol., ii, 128) is due to the use of copper sulphate in the Kjeldahl digestion. Hence if this substance is omitted the removal of oxygen is unnecessary. E. S.

Micro-estimation of Nitrogen. H. LUHRIG (*Pharm. Zentr.-h.*, 1921, **62**, 437—444).—A detailed procedure is given for the estimation of very small quantities of ammonia, protein nitrogen (by Kjeldahl's method), and nitric nitrogen (by reduction with iron). In each case the ammonia is separated by steam-distillation and collected in $N/200$-sulphuric acid; for very small quantities of ammonia it is preferable to estimate the excess of sulphuric acid iodometrically. W. P. S.

Micro-chemical Estimation of Nitrogen by Kjeldahl's Method. VLAD. STANĚK (*Zeitsch. Zuckerind. Cechoslov.*, 1921, **45**, 323—326, 335—338, 347—349).—Full working details are given of a modification of Pregl's method (*Die quantitative Mikroanalyse*, Berlin, 1917), which has given results as accurate as the ordinary Kjeldahl's method and with a great economy of reagents and time. Except for the use of a steel condenser tube the method only differs from the ordinary Kjeldahl method in quantitative respects, for example, the amount of material used may range from a few mg. upwards, digestion is carried out with 1—10 c.c.

of sulphuric acid in a flask of 25—30 c.c. capacity, the distillation flask has a capacity of 160 c.c., and $N/70$ acid is employed in the absorption flask. An electrical device for preventing irregular boiling in the distillation flask is described. [See also *J. Soc. Chem. Ind.*, 1921, Aug.] J. H. L.

A New Reaction of Ammonia. CONST. D. ZENGHELIS (*Compt. rend.*, 1921, **173**, 153—155).—The reagent is a 20% solution of silver nitrate containing 3% of a commercial solution (33—37%) of formaldehyde and is prepared immediately before use. The exposure of a drop of this reagent to an atmosphere containing ammonia results in the formation of a thin metallic mirror. The reaction is sensitive to 0·00000034 gram of ammonia. In applying the tests to salts the ammonia is liberated by warming with dilute alkali. W. G.

Use of "Fornitral" for the Detection and Estimation of Nitric Acid. (*Ann. Chim. Analyt.*, 1921, [ii], **3**, 207—208).—"Fornitral" consists of 2 mols. of formic acid combined with 1 mol. of *endo*-anilodiphenyldihydrotriazole. Five drops of a 10% solution of this substance yields a precipitate at once when mixed with 1 c.c. of a solution containing 0·03 mg. of nitric acid. For the estimation of nitric acid, 100 c.c. of a solution containing about 0·1 gram of nitric acid are acidified with 10 drops of dilute sulphuric acid, the mixture is boiled, and 10 c.c. of the reagent are added; the mixture is then cooled at 0° for two hours, the precipitate collected on a filter, washed with a small quantity of cold water, dried at 100°, and weighed. The weight found is multiplied by 0·168 to obtain the amount of HNO_3 present. W. P. S.

An Improved Gas Combustion Furnace for Use in Organic Analysis. THOMAS JOHNSON HEDLEY (T., 1921, **119**, 1242—1243).

Estimation of Calcium in Blood. M. KAHN and L. G. HADJOPOULOS (*Proc. Soc. Exp. Biol. Med.*, 1921, **18**, 200; from *Physiol. Abstracts*, 1921, **6**, 311).—The calcium is precipitated as oxalate, centrifuged, washed, dried, and ashed. The residue of calcium oxide is dissolved in $N/50$-hydrochloric acid and the excess of the latter titrated with $N/100$-sodium hydroxide, using phenolphthalein as indicator. C. R. H.

Estimation of Metal Sulphides by Heating in Hydrogen Sulphide. I. L. MOSER and ANNA SCHATTNER (*Chem. Zeit.*, 1921, **45**, 758—759).—Zinc, cadmium, manganese, and silver may be estimated gravimetrically by conversion into sulphide, followed by ignition of the dried compound in a current of dry hydrogen sulphide gas. The latter is prepared by the action of hydrochloric acid on ferrous sulphide, and is purified by passing it in succession through four wash-bottles maintained at 60°, and containing 1 : 2, 1 : 4, and 1 : 8 hydrochloric acid and water respectively, then through a wash-bottle containing cold water, a tube filled with potassium hydrosulphide, and lastly through a large U-tube packed with calcium chloride. The precipitated sulphides are dried, the

precipitate is detached from the paper, the latter ashed in a crucible, the main precipitate added, and the crucible supported in a Bunsen flame so that it is surrounded by about three-fourths of the flame. The crucible is covered with a perforated lid through the hole in which a glass tube, to deliver the gas, projects two-thirds of the way down the crucible. A steady stream of gas is passed through for $\frac{1}{2}$—$\frac{3}{4}$ hour while the bottom of the crucible is maintained at a dull red heat, and the gas current is kept on until the whole is quite cold. In this way the sulphides are obtained in a dense or crystalline form. By simple ignition in the above manner the following compounds may be converted into, and weighed as, sulphide—zinc oxide, carbonate, and sulphate, manganese sulphate, dioxide, and trimanganese tetroxide, silver chloride, or nitrate. If iron sulphide or oxide is treated in the above manner the residue contains higher sulphides of iron, but exact results may be obtained by diluting the hydrogen sulphide with five times its volume of hydrogen, and heating for half an hour, after which the residue is cooled in a current of hydrogen and weighed as FeS. A. R. P.

Gravimetric Analysis. XVIII. XXIII. Determination of Cadmium. L. W. WINKLER (*Chem. Zeit.*, 1921, **34**, 383—384).—On passing a current of hydrogen sulphide through a hot, strongly acid solution of cadmium sulphate containing a very small quantity of hydrochloric acid, a heavy, red, crystalline precipitate of cadmium sulphide containing 1·01% of SO_4 is obtained. A gravimetric method for the determination of cadmium based on this fact is carried out as follows. The neutral or slightly acid cadmium sulphate solution containing 0·25—0·01 gram of cadmium and about 100 c.c. in bulk, is treated with 3 c.c. of concentrated sulphuric acid and 1 drop of *N*-hydrochloric acid, heated to boiling and saturated with hydrogen sulphide for 15 minutes; then cooled to the ordinary temperature and again treated with the gas for 15 minutes. The precipitate is collected on a wad of cotton wool that has previously been washed with methyl alcohol and dried at 130°, washed with 50 c.c. of water containing a few drops of acetic acid and some hydrogen sulphide, then with methyl alcohol, dried first at the ordinary temperature, then at 130° for one hour and weighed. One mg. is added to the weight so found to allow for the cadmium that is not precipitated, and the figure is then converted to that for the pure sulphide by multiplying by 0·9806. Chlorides should be removed first by evaporation of the solution with an excess of 3 c.c. of sulphuric acid more than that necessary to decompose them. Sulphates of the alkali metals, magnesium, manganese, ferrous iron, cobalt, nickel, aluminium, or chromium do not interfere. Zinc is partly co-precipitated; in its presence, the precipitate should be re-dissolved in hydrochloric acid, the solution evaporated to dryness with sulphuric acid, the mass taken up in water, and the precipitation with hydrogen sulphide repeated. A. R. P.

Estimation of Small Amounts of Lead in Brass. FRANCIS W. GLAZE (*J. Ind. Eng. Chem.*, 1921, **13**, 553—554).—In determining lead electrolytically as lead dioxide, current density and acid

concentration are the most important variables. The following method has proved satisfactory for estimating lead in amounts less than 0·06%. 8·643 Grams of a sample of brass are treated with 30 c.c. of nitric acid (1 : 1) and then dissolved by adding 10—15 c.c. of nitric acid (*d* 1·42) and warming. The solution is evaporated until cupric nitrate begins to crystallise out, cooled, and heated with 5 c.c. of nitric acid and a small amount of water until the salt redissolves. After dilution to volume, it is electrolysed at a current of *N.D.* 100 of 1·5 amperes, and 2·9—3·1 volts. Deposition of the lead dioxide is complete in one hour, but the current should be continued for a further ten minutes. The anode is washed with water and alcohol, dried at 200—230° for half an hour, cooled, and weighed. After cleaning, it is again weighed, and the difference ×10 gives the percentage of lead in the brass. W. J. W.

The Titrimetric Estimation of Mercury. EINAR BIILMANN and (MLLE) KARIN THAULOW (*Bull. Soc. chim.*, 1921, [iv], **29**, 587—592).—Two methods are described. One is based on the fact that allyl alcohol reacts with mercuric salts to give an organo-mercuric compound, $C_3H_5{\cdot}OH+HgX_2=C_3H_5{\cdot}O{\cdot}HgX+HX$, which with alkali gives a hydroxide, $C_3H_5{\cdot}O{\cdot}HgX+NaOH=C_3H_5{\cdot}O{\cdot}Hg{\cdot}OH+NaX$, which is so feebly basic that it does not redden phenolphthalein. It reacts with potassium bromide to liberate an equivalent amount of potassium hydroxide, $C_3H_5{\cdot}O{\cdot}Hg{\cdot}OH+KBr=C_3H_5{\cdot}O{\cdot}HgBr+KOH$. To an acid solution of the mercuric salt, allyl alcohol is added together with a few drops of phenolphthalein and a slight excess of sodium hydroxide. The solution is exactly neutralised with acid, five grams of potassium bromide are added, and the alkali liberated is titrated with standard acid.

For the second method the salt is dissolved in dilute acid and the solution is supposed to be free from halogen ions or carbon dioxide. A few drops of phenolphthalein are added and an excess of sodium hydroxide. Dilute sulphuric acid is added until the red colour of the indicator exactly disappears and then 5 grams of potassium iodide are added. The action occurring is $HgO+2KI+H_2O=HgI_2+2KOH$. The alkali liberated is titrated with standard acid. W. G.

The Precipitation of some of the Rare Earths by Creams of Insoluble Oxides and Carbonates, based on the Principle of Hydrolysis. ARTHUR C. NEISH and J. W. BURNS (*Can. Chem. Met.*, 1921, **5**, 69—74).—An investigation of the hydrogen-ion concentration of some salts of the rare earths, and the hydroxyl-ion concentration of various oxides and carbonates has led to the development of the following scheme of analysis: The solution is treated with hydrogen sulphide or sulphur dioxide to reduce cerium compounds to the cerous condition, excess is removed by boiling, and the solution then treated in an atmosphere of carbon dioxide with a slight excess of lead, zinc, or copper carbonate, red lead or zinc oxide, whereby thorium hydroxide is precipitated; after being dissolved and reprecipitated, this is washed, ignited, and weighed. The original filtrate is treated with a small excess of

potassium permanganate, boiled, a slight excess of lead, manganese, or zinc carbonate, or red lead added, and the mixture quickly filtered from precipitated ceric hydroxide, which is estimated as before. To the filtrate is then added a slight excess of magnesium oxide or carbonate, or silver oxide; after being heated to 60° only, the liquid is filtered; neodymium and praseodymium are separated by fractional precipitation with ammonia of the redissolved residue, whilst lanthanum hydroxide is removed from the filtrate with sodium hydroxide. CHEMICAL ABSTRACTS.

The Estimation of Small Quantities of Iron. L. MAQUENNE (*Bull. Soc. chim.*, 1921, [iv], **29**, 585—587).—For the estimation of iron in plant products the material is ashed at a red heat and 0·01—0·05 gram of the ash is moistened with nitric acid and again calcined. To the residue 1 c.c. of 10% sulphuric acid is added and the mixture heated until white fumes are evolved. Three drops of hydrochloric acid and 1 c.c. of water are added, and the liquid is decanted into a tube of 3—4 c.c. capacity. The residue is washed with 1 c.c. of water. Any calcium sulphate in the decanted liquid is removed by centrifuging it. The clear liquid is decanted and a few drops of sodium phosphate and a very slight excess of ammonia are added, until a permanent precipitate is obtained. One c.c. of acetic acid is added and the ferric phosphate, which is insoluble, is separated by centrifuging and dissolved in three drops of hydrochloric acid, the solution being diluted to 2 c.c. and poured into a tube containing a few drops of potassium ferrocyanide, the iron then being estimated colorimetrically against standards. W. G.

Estimation of Small Quantities of Iron. L. MATHIEU (*Ann. Falsif.*, 1921, **14**, 203—204; cf. this vol., ii, 351).—Under proper conditions of illumination, the thiocyanate method is trustworthy for the estimation of very small quantities of iron. In the case of wine, the ash should be dissolved by heating with 10% sulphuric acid and the solution then treated with two drops of 10% nitric acid before the thiocyanate is added. W. P. S.

Estimation of Cobalt and Nickel in Cobalt Steels. G. E. F. LUNDELL and J. I. HOFFMANN (*J. Ind. Eng. Chem.*, 1921, **13**, 540—543).—In the electrolytic method of determining cobalt and nickel, vanadium interferes in the deposition of either alone, but not when both are electrolysed simultaneously. Tungsten affects the deposition of cobalt, or cobalt and nickel, but not of nickel alone. Ferrous salts, chromates, tartrates, and molybdenum exert marked interference, but sulphates of potassium, manganese, and chromium, chlorides, and small amounts of platinum, are without harmful effect. In the following method the action of interfering agents is avoided. The steel is dissolved in hydrochloric and nitric acids, and tungstic and silicic acids are filtered off and treated with sodium hydroxide. Insoluble matter is then filtered off, dissolved in hydrochloric acid, and added to the main solution. By treatment of this with ether, most of the iron and molybdenum are removed. The acid extract is heated with sulphuric acid until fumes are

evolved, chromium, vanadium, and manganese are oxidised with potassium persulphate, and the hot solution is added to hot sodium hydroxide solution and filtered, by which process chromium, vanadium, and any residual tungsten and molybdenum are removed. The precipitate is dissolved in sulphuric acid to which a little sodium bisulphite is added, and the copper separated by treatment with hydrogen sulphide. Iron is removed by double precipitation with ammonium hydroxide after expulsion of hydrogen sulphide and re-oxidation. The combined filtrates are then electrolysed for nickel and cobalt, which are weighed and dissolved, and the nickel is finally separated by treatment with dimethylglyoxime. If desired, separate estimations may be made of chromium, vanadium, manganese, and copper isolated by the above method. W. J. W.

Reactions of the Xanthates. A. Whitby and J. P. Beardwood (*Journ. Chem. Met. Soc. S. Africa*, 1921, **21**, 199—200).—Nickel and cobalt may be separated by the use of an alkali xanthate in the following manner: The solution is treated with 1 gram of citric acid, followed by ammonia until alkaline; 1 gram of sodium or potassium xanthate is then added and acetic acid until just acid, whereby nickel and cobalt are quantitatively precipitated. After remaining in a warm place for two to three hours, the solution is filtered, the precipitate well washed with warm water, rinsed back into the original beaker, and digested with 1 : 1-ammonia to dissolve the nickel compound. The insoluble residue of cobalt xanthate is collected, washed with ammonia until all yellow colour is removed from the paper, and ignited to Co_3O_4 which is weighed. The nickel in the filtrate is recovered by acidifying with acetic acid; the precipitate is collected, washed with warm water, ignited, and weighed as NiO. Copper, if present in the original solution, is found with the cobalt fraction; it may be removed by solution of the ignited oxides in hydrochloric acid, followed by precipitation with hydrogen sulphide. A. R. P.

Estimation of Small Amounts of Chromium in Steels. B. S. Evans (*Analyst*, 1921, **46**, 285—286).—The method depends on the red coloration obtained when chromic acid is treated with diphenylsemicarbazide solution, and is suitable for the estimation of quantities of 0·001%, or less, of chromium in iron. The reagent is prepared by dissolving 1 gram of diphenylsemicarbazide in 10 c.c. of glacial acetic acid and diluting the solution with water to 1 litre; 5 c.c. of the reagent and 10 c.c. of dilute (1 : 3) sulphuric acid are used for each test. W. P. S.

Detection of Antimony in Presence of Tin. Vladimir Njegovan (*Chem. Zeit.*, 1921, **45**, 681).—In hydrochloric acid solutions containing antimonious and stannic chlorides, as obtained in the ordinary course of qualitative analysis, the antimony may be detected by precipitation as red oxysulphide on boiling with sodium thiosulphate solution. The stannic salt gives at the same time a white precipitate of sulphide and hydroxide. If, for example, 1 c.c. of the hydrochloric acid solution is partly neutralised with

sodium carbonate but left acid enough to prevent separation of basic salts, and then boiled for one minute with one or two drops of $N/2$-sodium thiosulphate solution, antimony may be detected even at a concentration of $N/100$ in presence of $N/2$-stannic chloride, by the pink tint of the precipitate. Excess of thiosulphate must be avoided, as the precipitation of sulphur masks the red colour. Stannous chloride, if present, should be oxidised with nitric acid before the test. Any cupric salt present is precipitated as sulphide, thus masking the reaction, and in this case the liquid should be made slightly alkaline with sodium carbonate, warmed to dissolve the antimony oxysulphide, filtered from copper sulphide, acidified with hydrochloric acid, and heated again with thiosulphate.

J. H. L.

Methods of Estimating Cholesterol and Allied Substances. JOHN ADDYMAN GARDNER and MAY WILLIAMS (*Biochem. J.*, 1921, **15**, 363—375).—The estimation of coprosterol colorimetrically by means of acetic anhydride and sulphuric acid against coprosterol and cholesterol standards is influenced both by the volume of acid and by temperature. In estimating coprosterol against cholesterol, precautions ought also to be taken to avoid the difference in the time of the colour induction. ψ-Coprosterol cannot be estimated colorimetrically against either cholesterol or coprosterol. β-Cholestanol gives only a very faint colour reaction with acetic anhydride and sulphuric acid, which is most probably due to traces of cholesterol, and it cannot therefore be estimated colorimetrically. Cholesteryl acetate, benzoate, and stearate give the colour reactions as easily as cholesterol itself, but the quantitative results are rather high. With coprosteryl acetate, on the other hand, the colour changes are very slow. The presence of amorphous sterols from fæces vitiates the colorimetric estimation of cholesterol and coprosterol owing to the bright green coloration which they ultimately give. The colorimetric method cannot be applied to the estimation of the unsaponifiable matter of fæces. The ether extracts of serum or blood can be estimated colorimetrically. Results obtained with extracts from other tissues are untrustworthy.

S. S. Z.

Source of Error in the Colorimetric Methods for the Estimation of Cholesterol in Tissue Fats. JOHN ADDYMAN GARDNER and FRANCIS WILLIAM FOX (*Biochem. J.*, 1921, **15**, 376—378).—Alcoholic potassium hydroxide on being extracted with ether yields some resinous matter which when dissolved in chloroform gives a coloration with acetic anhydride and sulphuric acid. Such a coloration is sufficient to introduce an error in the estimation of cholesterol.

S. S. Z.

Micro-estimation of Dextrose by means of Potassium Permanganate. Application to Blood and Cerebro-spinal Fluid. G. FONTÈS and L. THIVOLLE (*Bull. Soc. chim. Biol.*, 1921, **3**, 226—237).—The method is a modification of that of Folin and Wu (A., 1919, ii, 308), the estimation being made volumetrically

instead of colorimetrically. In place of the phenol reagent, a phosphomolybdic acid reagent is used. This is prepared by boiling 40 grams of ammonium molybdate with 60 c.c. of sodium hydroxide (*d* 1·36) and 100 c.c. of water until ammonia is no longer evolved; after cooling, 200 c.c. of water and 200 c.c. of phosphoric acid (*d* 1·38) are added and the solution is again boiled for fifteen minutes. The cold solution is diluted to 1 litre. For the estimation, the protein free filtrate (2 c.c.) from blood or cerebro-spinal fluid containing 0·5—1 mg. of dextrose is boiled for six minutes with an alkaline copper tartrate solution (1 c.c.). Saturated solutions of magnesium sulphate (5 drops) and sodium carbonate (4 drops) are quickly added and the solution is again boiled for one minute. The cuprous oxide precipitate, after separation by centrifuging, is dissolved in the phosphomolybdic acid reagent (5 c.c.) and the blue solution so obtained titrated with a 0·008% potassium permanganate solution until the colour is discharged. The result is calculated by comparison with 2 c.c. of a 0·05% dextrose solution similarly treated. The observed error is 3—5%. The above quantities are modified for smaller concentrations of dextrose; the error in this case is greater. E. S.

[Colour Reaction for] Lignified Cell Membranes. P. Casparis (*Pharm. Monatsh.*, 1920, **1**, 121—160).—Lignified cell-walls are stained blue by adsorption of a 15—40% solution of cobalt thiocyanate tetrahydrate, the reaction being considerably more sensitive than either Maeule's permanganate test or the phloroglucinol test. Maeule's test is characteristic only of lignin commonly present in angiosperms, and consists of an oxidation and a chlorination phase; thus it is closely related to the "chlorosulphite" reaction of Cross and Bevan. Chemical Abstracts.

Dinitrosalicylic Acid: A Reagent for the Estimation of Sugar in Normal and Diabetic Urine. James B. Sumner [with V. A. Graham] (*J. Biol. Chem.*, 1921, **47**, 5—9).—A colorimetric method depending on the reduction of 3 : 5-dinitrosalicylic acid. One c.c. of 2% sodium dinitrosalicylate solution (prepared by dissolving 2 grams of dinitrosalicylic acid in water containing 10 c.c. of 20% sodium carbonate solution and diluting to 100 c.c.) and 2 c.c. of 1·5% sodium hydroxide solution are added to 1 c.c. of urine. The mixture is heated for five minutes and the amount of reduction determined by comparison with a standard in a colorimeter. To correct for the reduction due to uric acid and polyphenols, 1 c.c. of urine is heated for fifteen minutes with 1 c.c. of 3% sodium hydroxide; this destroys reducing sugars. An amount of dextrose approximately equal to that of the reducing sugars originally present is then added and the reduction determined as above. After deducting that due to the dextrose, this gives the correction to be applied. E. S.

General and Physical Chemistry.

Balmer Series of Hydrogen. E. GEHRCKE and E. LAU (*Ann. Physik*, 1921, [iv], **65**, 564—576).—The lines of the Balmer series of the hydrogen spectrum have been examined with respect to their structure, energy partition, and width. It is shown that the Balmer lines are more easily obtained in the presence of a little water. The intensity relationship of the two components is found to depend on the method of excitation and the source of light.

J. F. S.

Mass Spectra of the Alkali Metals. F. W. ASTON (*Phil. Mag.*, 1921, [vi], **42**, 436—441).—An apparatus for the production of positive rays of the alkali metals by volatilising their salts by means of a hot anode is described. The following results were obtained:

Element.	Lithium.	Sodium.	Potassium.	Rubidium.	Cæsium.
Minimum number of isotopes . . .	2	1	2	2	1
Mass of isotopes in order of intensity .	7, 6	23	39, 41	85, 87	133

It is shown that for the great majority of the possible configurations even atomic weight is associated with even atomic number and odd with odd, which is interpreted as meaning that in the nuclei of most types of atoms the number of electrons is an even number.

J. R. P.

Quantitative Relationships of the Cæsium Spectrum. HANS BARTELS (*Ann. Physik*, 1921, [iv], **65**, 143—166).—The series law put forward by Füchtbauer and Hoffmann (*Ann. Physik*, 1914, **43**, 96) has been examined in the case of the cæsium doublet $5p$ ($\lambda=3612$ and 3617) and found to be correct within the limits of experimental error. The absorption of the strongest component ($\lambda=3612$) of the principal series doublet $5p$ has been measured and by making use of earlier measurements has been compared with the absorption of the corresponding component of the doublet $4p$. From the absorption measurements by means of the Herz vapour pressure formula $\log_e p=A+B\log_e T+c/T$, several values of the vapour pressure of cæsium have been calculated. These values are: 190·9°, $p=0·046$ mm., 199·2°, $p=0·068$ mm., 204·7°, $p=0·084$ mm., 232·3°, $p=0·211$ mm. (cf. Kröner, A., 1913, ii, 383). These values probably have a 10% absolute error, and a relative error of 4%.

J. F. S.

Bergmann Series of Cæsium. K. W. MEISSNER (*Ann. Physik*, 1921, [iv], **65**, 378—392).—The vacuum arc spectrum of cæsium has been photographed and evaluated in the red and infra-red regions. Twenty-nine lines of wave-lengths 8079·021—6010·489 Å.U. are recorded, the values of which were obtained by reference to the red cadmium line $2p_2—4·5s$, 6354·552 Å.U. The

measured lines are used for the investigation of the Bergmann series. It is shown that various pairs have not a constant frequency difference, but the individual components come more closely together the larger the series number, and for the series number $m=\infty$ the difference Δ^{ν}_{∞} reaches the limiting value 97·59 cm.$^{-1}$. The two limiting terms necessary to characterise the series are found to be 16809·620 ($3d_1$) and 16907·190 ($3d_2$). Making use of these limiting values, the wave-lengths calculated and observed are compared and a remarkably good agreement is obtained.

J. F. S.

Arc and Spark Spectra of the Alkalis, Alkaline Earths, and Earths. R. SEELIGER and D. THAER (*Ann. Physik*, 1921, [iv], **65**, 423—448).—The arc and spark spectra of lithium, sodium, potassium, magnesium, calcium, zinc, mercury, and aluminium have been investigated. It is shown in all these cases that the displacement law is correct in so far as all the lines of the elements may be arranged in two groups of smaller and larger exciting energy. The energy necessary for the excitation of the arc lines increases from the alkalis to the earths through the alkaline earths. The energy necessary for excitation of the arc lines of one and the same element increases in the order : Bergmann series, principal series, second subsidiary series, first subsidiary series, single line series, spark lines. The unknown form of the excitation function has considerable influence in both the above cases. It is significant that in its entire behaviour the Bergmann series, of the whole arc series, is furthest removed from the spark lines. The spark spectrum (fundamental spectrum) of sodium has been observed in the negative glow of the glow discharge. The results concerning the intensity relationships at the edge of the glow discharge show that the exciting energy of the single line series is greater than that of the remaining arc series. Vigorous evaporation of the cathode in a glow discharge is not generally sufficient to lower the cathode potential to that characteristic lower value required for the arc, but an anomalous cathode fall may be set up over a vaporising molten cathode. J. F. S.

Absorption of Light by Elements in a State of Vapour. The Halogens. (SIR) J. J. DOBBIE and J. J. FOX (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 456—461; cf. A., 1920, ii, 170).—The absorption of light by iodine and bromine vapour and by chlorine has been examined at temperatures from 22° to 1350°. When light from a Nernst filament is allowed to fall on a white screen after passing through bromine vapour at various temperatures it is found that the colour, which is deep orange at ordinary temperatures, changes to brick red at 100°, the intensity of the transmitted light diminishes at 600° and above, and the vapour is most opaque at 900°. Above this point the colour changes to orange-red; at 1200° it is pale yellow, and at still higher temperatures nearly white. The absorption increases regularly up to about 900° and then falls off continuously. The absorption band has its middle situated at about λ4170. Iodine vapour changes colour on heating,

at temperatures up to 300° the colour being reddish-violet, which deepens in shade up to 500°. At this temperature, the intensity of the transmitted light is much enfeebled and remains so to 800°, when it again increases, the violet shade becoming lighter. At still higher temperatures, the violet shade passes gradually into a bright salmon colour, and finally disappears almost entirely. The absorption increases regularly to 600°, and is much more distinctly defined than in the case of bromine. In the case of chlorine, the absorption becomes greater with increase of temperature up to 1190°, but up to this temperature no reversal is observed as in the other cases. The results are discussed in connexion with the dissociation and size of the molecules of the halogens. J. F. S.

Colorations produced by Substituted Nitroforms. HUGH GRAHAM and ALEXANDER KILLEN MACBETH (T., 1921, **119**, 1362—1368).

Criticism of Bohr's Theory of Light Emission. A. SOMMERFELD (*Jahrb. Radioaktiv. Elektronik*, 1921, **17**, 417—429).—The author supports Bohr's theory against criticisms of J. Stark (this vol., ii, 232). J. R. P.

Significance of Continuous Absorption and Emission Spectra in Bohr's Theory. R. LADENBURG (*Jahrb. Radioaktiv. Elektronik*, 1921, **17**, 430—434).—Polemical with J. Stark (see preceding abstract). J. R. P.

Luminescence of Solid Solutions. GERHARD C. SCHMIDT (*Ann. Physik*, 1921, [iv], **65**, 247—256).—The author has examined the luminescence of a number of dyes adsorbed in other material and finds that in no case is any fluorescence to be observed; on the other hand, the same dyes when in solid solution in gelatin or phthalic acid exhibit a very pronounced fluorescence. Among the dyes examined were bismarck-brown, quinoline-yellow, congo-red, ponceau-red, eosin, methylene-blue, and methyl-violet. The difference noted above can be shown with one and the same substance as solvent or adsorbent; thus benzoic acid in which methyl-violet is adsorbed shows no fluorescence, whilst when the methyl-violet is dissolved in the acid to form a solid solution a very intense yellowish-red fluorescence is observed. It is shown further that the fluorescence of fluorescein, eosin, and fluoridin in benzidine, benzoic acid, phthalic acid, acetamide, benzamide, and acetanilide is the same in both liquid and solid solutions. The adsorption of methyl-violet in benzoic acid from aqueous solution follows the partition law. The author attributes the different behaviour in the two cases to the different condition of the dye substance; in the case of adsorption, the dye lies on the surface, but in the case of solid solutions the dissolved substance lies in the crystal lattice of the solvent. The difficulty of formation of solid solutions in inorganic substances is considered and explained. J. F. S.

Active Racemic Substances. MARCEL DELÉPINE (*Bull. Soc. chim.*, 1921, [iv], **29**, 656—669).—A discussion of the literature on

this subject, in which the author adopts the more general definition of a racemic compound as a crystalline edifice composed of molecules of dextrorotatory configuration and of lævorotatory configuration in equal numbers. Optical activity is only an accessory phenomenon dependent on the quality of each molecule. This is amplified by illustrations showing the possibility of obtaining active racemic compounds. W. G.

Temperature Coefficient of the Electrical Double Refraction in Liquids. II. C. Bergholm (*Ann. Physik*, 1921, [iv], **65**, 128—142; cf. *ibid.*, 1916, **51**, 414).—The temperature coefficient of the electrical double refraction has been determined, by the method previously adopted, for the liquids: toluene, *m*-xylene, carbon disulphide, chlorobenzene, bromobenzene, chloroform, ethyl ether, ethylene dibromide, and carbon tetrachloride. It is shown that the agreement between the observed and calculated values of the temperature coefficient is only qualitative. The relationship, B_{t°/B_{20°, between the Kerr constant at t° and 20° in the case of toluene and carbon disulphide is very nearly dependent on the wave-length of the light used. In the case of liquids with a more positive Kerr constant, B_{t°, the expression $B_{t^\circ}T/(\epsilon+2)^2$ is very nearly constant, ϵ being the dielectric constant at t°.

J. F. S.

New Application of Einstein's Photochemical Equivalent Law. Walter Noddack (*Zeitsch. Elektrochem.*, 1921, **27**, 359—364).—The photochemical reactions between bromine and *cyclo*hexane and between chlorine and trichlorobromomethane have been investigated. In the former case a slow, dark reaction takes place; in the latter no recognisable change takes place in forty days at 37°, but some reaction occurs at 100° in several hours (see this vol., ii, 580). It is shown that both reactions follow the Einstein photochemical equivalent law, the divergences observed being explained by the experimental error and by the complicated dark reaction. In the case of the reaction between chlorine and trichlorobromomethane, it is found that admixture with carbon tetrachloride lowers the photochemical effect with increasing dilution. This phenomenon is ascribed to the energy loss of the activated molecules owing to indifferent collisions with the carbon tetrachloride molecules. The illumination of the mixture: chlorine, trichlorobromomethane, carbon tetrachloride, represents a limiting case of pure photochemistry and in it the light energy is partly converted into chemical energy and partly into heat. The life of the Bohr condition has been deduced from the decrease of the photochemical effect, and is found to be approximately 10^{-9} seconds.

J. F. S.

Photographic Colloid-Chemical Crystallisation Processes. A. Steigmann (*Kolloid Zeitsch.*, 1921, **29**, 145—148; cf. this vol., ii, 13, 147).—A theoretical paper in which the author discusses the results obtained in previous papers (*loc. cit.*). J. F. S.

Passivity and Photo-electricity. WILHELM FRESE (*Zeitsch. wiss. Photochem.*, 1921, **21**, 37—44).—The connexion between passivity and the photoelectric sensitiveness of metals has been examined (Allen, A., 1913, ii, 172). It is shown that the photoelectric sensitiveness of iron, zinc, and aluminium is greatly reduced after treatment with alcohol or water. In the case of copper, cobalt, nickel, silver, gold, and palladium, a similar treatment brings about only the slightest reduction of the photoelectric sensitiveness; in the case of platinum there is no change at all. All oxidising agents, which render iron, nickel, and cobalt passive, strongly reduce the photoelectric sensitiveness, whilst reducing agents, particularly nascent hydrogen, increase it. The above action is more intense the longer the reagents remain in contact with the metal. The same phenomenon is observed in the case of platinum and palladium, and also in metals which do not become passive, proving that the parallelism between passivity and photoelectric sensitiveness as found by Allen (*loc. cit.*) is incorrect. In the case of gold, silver, zinc, copper, and aluminium, the photoelectric sensitiveness is greatly reduced by oxidising agents and increased by reducing agents. The above results are explained as follows. The reduction of the photoelectric sensitiveness of iron, aluminium, and zinc by treatment with alcohol or water is attributed to the formation of a thin film of oxide. That no such action occurs in the case of the nobler metals is due to the greater difficulty experienced in oxidising these elements. The great increase in the photoelectric sensitiveness brought about by hydrogen points to the fact that hydrogen is the carrier of photoelectric sensitiveness. That all metals when charged with hydrogen become strongly photoelectric supports this view. J. F. S.

***X*-Ray Bulb with Liquid Mercury Anticathode and Wave-Length Measurements of the *L*-Spectrum of Mercury.** ALEX MÜLLER (*Phil. Mag.*, 1921, [vi], **42**, 419—427).—An arrangement is described in which an anticathode of liquid mercury is bombarded by cathode rays for the production of the *X*-ray spectrum. The wave-lengths of 14 lines in the *L*-spectrum are given, varying from 834·8—1418·3 ($\times 10^{-11}$ cm.). J. R. P.

Effect of the Rays from Radium, *X*-Rays, and Ultra-violet Rays on Glass. J. R. CLARKE (*J. Soc. Glass Technology*, 1921, **5**, 155—165).—A series of soda-lime glasses of the same composition, except that some contained selenium, some cobalt oxide, and others no admixture, have been exposed to the action of α-, β- and γ-rays, β- and γ-rays, γ-rays, *X*-rays, and ultra-violet rays respectively. All glasses containing selenium or cobalt oxide were coloured brown by β-rays, the depth of coloration corresponding with the range of the β-particles in the glasses. The intensity of coloration was greatest at the surface, decreased toward the interior, and increased with increasing selenium or cobalt oxide content. As the radiation was prolonged, the intensity increased to a maximum which depended on the percentage of colouring agent, and then remained constant. The pure soda-lime glass was only affected by α-rays,

being faintly coloured on the surface only. None of the glasses were affected by X-rays, γ-rays, or ultra-violet rays. All the glasses fluoresced in radium emanation, but a fatigue effect was observed at about the same time as the attainment of maximum intensity of coloration. The coloration of glasses is regarded as due to the formation of colloidal particles in the glass. The presence of such particles is explained as being due to the action of α- or β-rays on ions already present in the glasses. The fluorescence is held to be due to mechanical bombardment of the glass molecules by the rays. J. F. S.

Soft Characteristic X-Rays from Arcs in Gases and Vapours. F. L. MOHLER and PAUL D. FOOTE (*J. Washington Acad. Sci.*, 1921, **11**, 273—274).—If an electron current is maintained by a potential V between a hot cathode and anode in a vapour at low pressure, successive changes in the spectrum excited by electron impact occur, as V is increased. The maximum frequency of each additional group of lines, ν, is related to the minimum exciting potential by the quantum equation $Ve=h\nu$. The stages in the discharge were studied by measuring the photoelectric effect of the radiation on two other electrodes entirely shielded from ions produced in the arc. The photoelectric current plotted as a function of the exciting voltage shows nearly a linear relation with changes of slope at critical potentials. In this way potentials are found which are determined by the limiting frequency of the softest X-ray series of sodium, magnesium, phosphorus, sulphur, chlorine, carbon, nitrogen, and potassium. A new X-ray series of feeble intensity was detected. J. R. P.

Nickel Isotopes. F. H. LORING (*Chem. News*, 1921, **123**, 81).—Certain modifications in previous calculations (see A., 1920, ii, 171) are made in view of the announcement of the existence of isotopes of nickel, of atomic weights 58 and 60, by Aston (*Nature*, 1921, **108**, 520). J. R. P.

Variation of Resistance of Selenium with Temperature. SNEHAMOY DATTA (*Phil. Mag.*, [vi], **42**, 463—470).—The change of resistance of selenium with temperature is given by the equation $R_t=[65{\cdot}01+0{\cdot}86t+0{\cdot}0029t^2]\times10^5$ ohms. The constants depend on annealing and on the past history of the cell. Not more than 0·04 of the "light effect" is attributable to the heat produced by light. A change of colour accompanies the change in resistance on warming crystals of selenium produced by sublimation. The experiments suggest that if transformation into allotropic forms occurs, as seems probable, this takes place at all temperatures and the various modifications are in dynamic equilibrium, the quantity of each variety depending on the temperature. The degree of stability of each modification depends on the time during which it is maintained at one temperature. J. R. P.

Chemical Action of the Electric Discharge. I. G. POMA (*Gazzetta*, 1921, **51**, ii, 58—70).—A critical résumé is given of the different views which have been expressed regarding the nature of

the mechanism of the chemical actions exerted by the electric discharge (cf. following abstracts). T. H. P.

Chemical Action of the Electric Discharge. II. G. POMA and G. BASSI (*Gazzetta*, 1921, **51**, ii, 71—79).—The vapours of a number of organic compounds have been subjected to the action of an intense explosive discharge from an induction coil, the resulting mixture of products being analysed. Compounds of low molecular weight lead to no separation of carbon, this commencing with compounds containing four atoms of carbon in the molecule and increasing with more complex compounds. Compounds with several oxygen atoms in the molecule form, in addition to carbon, water and various organic compounds, the latter in proportions too small to admit of analysis.

Methyl alcohol decomposes almost completely in accordance with the equation $CH_3 \cdot OH = CO + 2H_2$, only small proportions of carbon dioxide, acetylene, and methane being formed. With the higher alcohols, however, considerable quantities of acetylene and methane are obtained; the proportions of acetylene and carbon monoxide appear to depend solely on the molecular weight of the alcohol, whereas those of methane and hydrogen are influenced also by the molecular structure, the methane increasing with the proportion of methyl groups in the molecule.

Formic acid vapour gives approximately 1, 2, and 1 vols. of carbon dioxide, carbon monoxide, and hydrogen respectively, together with small amounts of acetylene and methane; the decomposition evidently occurs in two ways, represented by the equations, $H \cdot CO_2H = CO_2 + H_2$ and $2H \cdot CO_2H = 2CO + 2H_2O$. When, however, the molecular weight is increased, either by esterification of the formic acid or by passage to higher homologues, the proportion of carbon dioxide formed diminishes considerably, but not regularly. T. H. P.

Chemical Action of the Electric Discharge. III. G. POMA and A. NESTI (*Gazzetta*, 1921, **51**, ii, 80—94).—By means of a Siemens ozoniser the action of the dark electric discharge on the vapours of a number of compounds has been investigated. With methyl alcohol, the mixture of gaseous products formed has the following percentage composition by volume: carbon monoxide, 10·8; methane, 15·5, and hydrogen, 73·3; formaldehyde is produced, but the other liquid and solid products of the reaction have not yet been investigated. The changes taking place are probably represented by the equations: $CH_3 \cdot OH = CO + 2H_2$, $2CH_3 \cdot OH = 2CH_4 + O_2$, and $CH_3 \cdot OH = H \cdot CHO + H_2$; the oxygen liberated probably unites with hydrogen to form water.

With ethyl alcohol, the gaseous products contain, in percentages: carbon dioxide, 2·2; carbon monoxide, 4·4; acetylene and ethylene, 9·0; methane and ethane, 26·0, and hydrogen, 59·0; acetaldehyde and other products are also formed. In the case of formic acid, the decomposition appears to take place according to the two equations, $H \cdot CO_2H = CO_2 + H_2$ and $2H \cdot CO_2H = 2CO + 2H_2O$, the gaseous products containing 22·4% of carbon dioxide, 53·6% of

carbon monoxide, and 23·8% of hydrogen; the liquid product distils completely. With acetic acid, the gaseous products have the percentage composition: carbon dioxide, 35·4; carbon monoxide, 18·5; methane and ethane, 17·3, and hydrogen, 28·3, and are apparently formed by the reactions, $2CH_3{\cdot}CO_2H{=}2CO_2+C_2H_6+H_2$ and $CH_3{\cdot}CO_2H{=}CH_4+CO_2$; the liquid product distils without residue. In the case of acetone vapour, the electrical conductivity is greater than with the above compounds, and less gaseous products are formed, the percentage composition of these being: carbon dioxide, 1·6; acetylene and ethylene, 5·0; carbon monoxide, 38·1, and methane and ethane, 55·3; hence for the gaseous phase the principal reaction is $CH_3{\cdot}CO{\cdot}CH_3{=}CO+C_2H_6$. The liquid products contain a γ-diketone, probably acetonylacetone. With methyl ethyl ketone vapour, the gaseous products have the percentage composition: acetylene and ethylene, 12·5; carbon monoxide, 32·8; methane and ethane, 43·6, and hydrogen, 10·2; the liquid products were shown to contain *s*-dimethylacetonylacetone, but were not analysed completely.

In general, the dark electric discharge favours endothermic chemical reactions, although in some cases it may determine the sudden rupture of a false equilibrium, and hence cause an exothermic reaction. To a certain point parallelism exists between the action of the dark electric discharge and that produced by a rapid rise in temperature, although such parallelism is evidently imperfect. T. H. P.

Anodic Behaviour of Metals in Non-aqueous Solutions. II. Behaviour of Various Metals in Acetone Solutions. UMBERTO SBORGI and PAOLO MARCHETTI (*Nuovo Cim.*, 1921, [vi], **22**, 151—175).—The authors have investigated the anodic behaviour of various metals in acetone solutions of lithium chloride and silver nitrate, the apparatus and methods employed being identical with those used in the experiments on methyl alcoholic solutions (*Atti R. Inst. Veneto*, July, 1921).

In saturated solution of lithium chloride in acetone, anodes of nickel, cobalt, iron, zinc, and cadmium dissolve as bivalent metals and copper as a univalent metal, whilst aluminium dissolves to an extent greater than that calculated for a tervalent metal. The various phenomena accompanying the attack of the metal, such as formation of precipitates, coloration of the anodic liquid, etc., are discussed for each case. At the platinum cathode there takes place evolution of gas, deposition of lithium and lithio-acetone, and formation of precipitates containing the anode metal.

In saturated solutions of silver nitrate in acetone, anodes of iron, nickel, and cobalt exhibit passivity under various conditions and those of lead and aluminium show partial mechanical passivity, whilst copper is dissolved as a bivalent metal; the passifying influence of acetone is evident in all these cases.

These results and those obtained with nickel anodes in methyl alcoholic solutions (*loc. cit.*) show that metals that are passive and anions which are passifying in aqueous solutions exhibit the same

characteristics in non-aqueous solutions, although the solvent itself also exerts a decided influence. T. H. P.

Hydration of the Lithium Cation. J. Barborovský and V. Hanák (*Chem-Listy*, 1921, **15**, 3—5).—The authors determined by a direct gravimetric method the increase in weight of the solution of lithium chloride at the cathode. The amounts of lithium chloride and water that were carried to the cathode were calculated from the difference between the initial and final concentrations of the cathode solution. These data yielded the transport number of the lithium ion and the amount of water associated with the lithium ion. Presupposing that the chloride ion has no affinity for water, it is indicated that eighteen molecular proportions of water are linked with the lithium ion. Chemical Abstracts.

Application of the Law of Mass Action to Strong Electrolytes and the Derivation of the General Equation of the Ionisation Isotherm. William Hughes (*Phil. Mag.*, 1921, [vi], **42**, 428—431).—The equation previously deduced (this vol., ii, 481) is applied to obtain a general relation between V and α, of which the equations of Ostwald, Rudolphi, van't Hoff, and Partington are special cases. Complete ionisation need not be assumed, and the law of mass action holds good in the case of strong electrolytes if active mass is represented by a momentum term, as is necessary in all applications of the law. The suggestion that the abnormality of strong electrolytes is due to the abnormal osmotic behaviour of the ions is in entire agreement with the fundamental assumptions made. J. R. P.

The Transformation of Iron at the Curie Point. P. Dejean (*Compt. rend.*, 1921, **173**, 412—414).—A comparison of the intensity of magnetisation of a cylindrical steel bar 1·2 m. long and 20 mm. in diameter with that of a similar bar composed of 120 small cylinders 10 mm. long and 20 mm. in diameter having varying definite interspaces between the small cylinders. The variation of the intensity of magnetisation with the interspace is of the same type as its variation with temperature. This is explicable if an increase in temperature provokes a progressive spreading of the elementary magnets in the bar. This may be produced by a progressive transformation of a magnetic α-form, stable in the cold, into an isomorphous, non-magnetic β-form, stable at higher temperatures or simply by a spreading of the magnetic elements progressive with rise in temperature. W. G.

The Importance of Experiments at Very Low Temperatures. C. A. Crommelin (*Chem. Weekblad*, 1921, **18**, 483—487, 499—503, 515—519).—A discussion chiefly of the work of Kamerlingh Onnes and his co-workers at Leiden on critical point phenomena, and the relation between magnetic susceptibility and temperature. S. I. L.

Relationships of the van der Waals Constants. W. Herz (*Zeitsch. Elektrochem.*, 1921, **27**, 373—375).—A theoretical paper in

which it is shown that van der Waals's constants, a and b, in the case of non-associated liquids, can be calculated from: the number of atoms in the molecule (n), the number of valencies in the molecule (z), from critical data, and other constants. In the case of the constant b, the value may be ascertained by the expressions (1) $b=412n10^{-6}$; (2) $b=201z10^{-6}$; (3) $b=795\cdot16M^2 10^{-4}/T_s^2 d_s$; (4) $b=12354d_s 10^{-3}/p_k^2$. The value of b as calculated by each of these expressions is recorded for twelve substances and the results are compared with the standard values. It is shown that there is an approximate agreement among the values, those obtained from formula 4 being the least in agreement. The constant a calculated from, (5) $a=5\cdot094nT_k 10^{-6}$; (6) $a=2\cdot49z\cdot T_k 10^{-6}$; (7) $a=4\cdot5846n^2 p_k 10^{-6}$; (8) $a=1474\cdot713M^2 10^{-6}/T_s d_s$ and (9) $a=239920d_s T_s 10^{-6}/p_k^2$. The value of a is calculated by all the above formula for eleven substances, and a fair general agreement with the accepted values obtained. A formula is developed whereby the coefficient of expansion of normal organic liquids may be calculated from the van der Waals constants. This has the form $K_{20}=1\{(a/0\cdot00618b)-293\}$. The agreement between the value of K_{20} calculated by the above formula and the experimental value is moderate. J. F. S.

Nernst's Heat Theorem and Chemical Constant. EIICHI YAMAZAKI (*J. Tokyo Chem. Soc.*, 1920, **41**, 19—35).—A mathematical paper, in which the explanations of the constant by Nernst and by Sackur are criticised. Calculated values, in good agreement with Nernst's values, are given for a number of substances. CHEMICAL ABSTRACTS.

Influence of Chemical Constitution on the Thermal Properties of Binary Mixtures. IV. The Constituents of Anthracene Oils. PAUL PASCAL (*Bull. Soc. chim.*, 1921, (iv), **29**, 644—656; cf. A., 1913, ii, 292, 304, 1031).—The author has determined the melting-point curves of binary mixtures and some ternary mixtures of anthracene, phenanthrene, acridine, carbazole, retene, chrysene, and 4-methylacridine. Anthracene, phenanthrene, and carbazole, taken two by two or all three together, give a continuous series of mixed crystals. The melting-point curves of binary mixtures containing acridine as one component always show a minimum point. The introduction into a binary mixture of a constituent with an unsymmetrical molecule almost always results in isodimorphism, except in some cases when the lack of symmetry is due simply to the structure of side chains substituted in two symmetrical nuclei. W. G.

Standardised Method for the Determination of Solidification Points, especially of Naphthalene and Paraffin. R. M. WILHELM and J. L. FINKELSTEIN (*Bur. Standards, Sci. Papers*, 1919, **340**, 158—197).—The apparatus consists of a test-tube with thermometer and glass stirrer air-jacketed by insertion through the cork of a wide-mouthed bottle, which is immersed in a water-bath. The solidifying point corresponds with the first series of five or more readings, during which the temperature remains constant

($\pm 0{\cdot}02°$). Usually under-cooling will occur, in which case the constant temperature should be observed immediately after the under-cooling ceases. CHEMICAL ABSTRACTS.

The Efficiency of certain Fractionating Columns in Distillation in a Vacuum. Some Laboratory Designs. L. SMITH (*J. pr. Chem.*, 1921, **102**, 295—304).—A preliminary account is given of the use of a large number of fractionating columns in the distillation of a mixture of glycerol monochlorohydrins under diminished pressure. The viscosity of the mixture inhibits the employment of all those types in which heads are used. It is found that the bulbous columns (including the Young " evaporator " still-head) have in general little efficiency and are markedly inferior to the " rod and disk " and Vigreux types. The reason of this is to be found in the incomplete mixing of the vapours in the more voluminous apparatus, a defect which must be more apparent in vacuum than in ordinary distillation, on account of the much greater velocity of the stream of vapour. The rate of distillation has an unexpectedly great effect on the separation; an efficient Vigreux column did not give any better result than the worst head when the rate of distillation with the former was two and a half times as great as with the latter. Efficient separation can only be obtained by distilling as slowly as possible, but, under these conditions, it is exceedingly difficult to keep the process uniform. H. W.

The Arrangement of the Molecular Volumes of the Oxides in the Periodic System. D. BALAREFF (*J. pr. Chem.*, 1921, **102**, 283—286).—A new table of molecular volumes of solid oxides is given. The graph showing the connexion between this factor and the atomic weights of the elements does not exhibit any striking regularity. The curves of the individual sub-groups are more uniform, eight of them having a minimum in the first portion. H. W.

Influence of Temperature on the Viscosity of Normal Liquids. EDM. VAN AUBEL (*Compt. rend.*, 1921, **173**, 384—387).—The variation of the viscosity of normal liquids with temperature may be represented by the equation $\phi=m+n \log (\theta-t)$, where ϕ is the inverse of the viscosity, t is the temperature observed, θ is the critical temperature of the liquid, and m and n are constants. This equation is verified in the cases of chlorobenzene, ethyl acetate, and benzene. W. G.

The Dimensions of the Molecules of Fatty Oils and some Phenomena of Molecular Solutions. PAUL WOOG (*Compt. rend.*, 1921, **173**, 387—390; cf. *ibid.*, 1921, **173**, 303).—If a solid saturated fat and an unsaturated liquid fat in separate benzene solutions are poured successively on to water the products cover a surface equivalent to the sum of the areas of the molecules considered separately. They orientate freely on the water and do not influence one another. If, however, the two fats are dissolved together in benzene and the solution is poured on to water, the area covered

by the mixed molecules differs from the area calculated by addition. This phenomenon is attributed to an influence of the unsaturated molecules on the solid molecules. W. G.

Behaviour of Cotton and Wool toward Substantive Dyes. R. Haller (*Kolloid Zeitsch.*, 1921, **29**, 95—100).—It has been shown that diamine-blue-3R dyes vegetable fibre, as instanced by cotton, blue, whilst animal fibre is dyed corinth-red, as shown by wool. The behaviour of this dye has been investigated. It is shown that, as in the case of congo-rubin (this vol., ii, 28) solutions of diamine-blue-3R consist of particles of different degrees of dispersion. The highly disperse particles are corinth-red in colour, whilst the less dispersed particles are blue. These two types of particles may be readily separated by ultra-filtration. It is pointed out that generally cotton is dyed by the larger particles and wool by the more dispersed particles. This point is considered in connexion with the acid dyes and the benzidine dyes; the former are very highly dispersed whilst the latter consist of much larger particles, and it is the former class which dyes wool. It is pointed out that for each type of fibre (animal or vegetable) there is a definite specific degree of dispersion of the dye necessary for the maximum colour effect. In the cases of congo-rubin (*loc. cit.*) and diamine-blue-3R it has been shown that the degree of dispersion may be changed by the addition of neutral salts; hence it follows that by the use of a suitable concentration of a given neutral salt every substantive cotton dye is capable of becoming a usable wool dye. J. F. S.

The Determination of Surface Tension from the Rise in Capillary Tubes. Samuel Sugden (T., 1921, **119**, 1483—1492).

Application of Dalton's Law to Concentrated Solutions. Radu Cernatesco (*Ann. sci. Univ. Jassy*, 1920, **10**, 259—292; from *Chem. Zentr.*, 1921, iii, 199).—The freezing-point depressions of pairs of non-electrolytes were determined separately and when mixed for the same solvent. The osmotic pressure of the mixture may be less or greater than the sum of the osmotic partial pressures. The relation of the osmotic pressure to the sum of the partial pressures may also be reversed with increase or decrease of concentration. The Abegg formula is inadequate, and the facts can only be explained with the help of van der Waals's theory. A new formula for the osmotic pressure of mixtures, based on the modified Nernst formula of Bogdan (*Chem. Zentr.*, 1916, i, 1006) is devised. The anomalies observed in freezing-point depressions with strong electrolytes are probably due also to the fact that observed depressions are not equal to the separate partial depressions. G. W. R.

Formation and Stability of Modifications of Polymorphous Substances Below their Transition Temperature. O. Mügge (*Centr. Min.*, 1921, 504—505).—In reply to Brauns's criticism of the author's explanation of the genesis of doubly refracting boracite (this vol., ii, 387), it is pointed out that in the case of this mineral the transition from the highly symmetrical to the mimetic modi-

fication takes place with such rapidity that it is unlikely that growth could ever take place in the former modification at a low temperature. A temperature of 265° is assumed to have occurred only locally as a result of chemical processes. E. H. R.

Low Concentrations in Colloid Chemistry. H. R. KRUYT (*Chem. Weekblad,* 1921, **18**, 475—479).—A paper recapitulating the present knowledge of the influence of traces of electrolytes on the stability of colloidal sols. S. I. L.

Sulphide Sols. II. Sol Preparation by means of Gaseous Hydrogen Sulphide. FRIEDRICH-VINCENZ VON HAHN (*Kolloid Zeitsch.*, 1921, **29**, 139—143).—The author has investigated the production of metallic sulphide sols by the action of gaseous hydrogen sulphide on solutions of salts. The influence of temperature, rate of passage of the gas, and duration of the treatment on the stability of the resulting sol has been particularly considered. These three factors are shown to have a determining influence on the stability. The velocity of precipitation is known to have a considerable influence on the dispersion of the resulting system. The more rapid the formation the greater in general is the degree of dispersion. In the present case, the formation of the precipitate reaches its maximum velocity when the duration of treatment with the gas has reached a definite value; consequently further treatment is without any influence on the stability of the system. The same applies to the temperature; that is, there is a particular temperature at which the velocity of precipitation, the dispersion, and the stability of the sol produced are at a maximum and further increase of temperature is without influence. The velocity of precipitation increases also with the rate of passage of the gas. All three factors tend to increase the velocity of formation and thereby the degree of dispersion, which means an increase in the stability (cf. this vol., ii, 40). J. F. S.

Theory of Gels. III. SAMUEL CLEMENT BRADFORD (*Biochem. J.*, 1921, **15**, 553—562; cf. A., 1920, i, 452).—The reversible sol-gel transformation of the natural emulsoids is an extreme case of crystallisation and solution in conformity with von Weimarn's ideas. The true solubility of gelatin in water at 18° is 0·12 gram per 100 c.c. A 0·13% solution is metastable and has a blue opalescence. On slight increase of concentration, the gelatin is deposited as particles, mostly just below microscopic size. A further increase of concentration increases the bulk of the precipitate, the particles decrease in size, and at about 0·7% the precipitate fills the solution as a white, cloudy jelly. Similar results were obtained with agar, and small sphærites with starch. Clear gelatin gels become opalescent and develop sphærites on prolonged keeping. G. B.

General Colloidal Chemistry. II. Time Change of Colloidal Stannic Acid after Peptisation with Alkali Hydroxide Solution. ADOLF STIEGLER (*Kolloid Zeitsch.*, 1921, **29**, 65—81).—The electrical conductivity and hydrogen-ion concentration of solutions of

stannic acid in potassium hydroxide of varying concentrations have been determined at 25° at various times over long periods. It is shown that colloidal stannic acid after peptisation with potassium hydroxide shows a change in its specific conductivity with time. With a series of solutions of stannic acid of different amounts of stannic acid in a solution of potassium hydroxide of constant composition, it is found that the solutions richer in tin undergo an immediate increase in specific conductivity, whilst the solutions poorer in tin at first suffer a decrease in conductivity followed by an increase. The increase in conductivity continues for months at a steadily decreasing rate. The concentration of hydroxyl ions decreases with time and is complete in about eight days. The specific conductivity of the colloidal portion has, in hydroxide solutions of all concentrations, a final value for the conductivity which is two to three times the initial value. The cause of the change in conductivity is considered, and shown not to be due to "temporary hydrolysis," as has been previously thought. The reactions represented by the equations (*a*) $AB+HOH \rightleftarrows AH+BOH$; $mBOH+nAB \rightleftarrows mBOHnAB$; (*b*) $AB+HOH \rightleftarrows AH+BOH$; $2BOH \rightarrow B_2O+H_2O$, may be taken as representing the cause of the conductivity changes. J. F. S.

The Hydration of the Fibres of Soap Curd. I. The Degree of Hydration determined in Experiments on Sorption and Salting Out. JAMES WILLIAM MCBAIN and HERBERT ERNEST MARTIN (T., 1921, **119**, 1369—1374).

The Hydration of the Fibres of Soap Curd. II. The Dew-point Method. JAMES WILLIAM MCBAIN and CYRIL SEBASTIAN SALMON (T., 1921, **119**, 1374—1383).

Structures in Disperse Systems. G. WEISSENBERGER (*Kolloid Zeitsch.*, 1921, **29**, 113—124).—A theoretical paper in which the structure of disperse systems is considered on the basis of a large amount of work published by the author and others. It is shown that solutions of dispersoids, when a definite concentration is exceeded, possess a tendency whereby the particles assume an ordered arrangement. The cause of this is found in the interference with the free spatial movement of the particles. Consequently, the phenomenon is not observed in suspensoids, since these have particles which, not being surrounded by a water sheath, are very small and their free movement is not interfered with until the concentration becomes very great. On the other hand, emulsoids and pseudo-emulsoids, which have particles surrounded by water sheaths and consequently may be very large, are systems in which the hindrance to free motion may be very great and is readily observed. Even at low concentrations, this occurs and furnishes the tendency to the structure formation. The elements of structure formation are the primary particles (micellæ); these may be either of a crystalline nature or a conglomeration of molecules. The arrangement of the molecules in these aggregates follows definite laws, since in similar circumstances

the same aggregates are always produced, but a change in the conditions brings about a change in the size and density of the aggregate. The primary particles are resistant and are the carriers of chemical reactions; they may preserve their size and other properties unchanged through a chemical reaction. In emulsoids and dispersoids, small discontinuities are often observed microscopically. These are not accidental, since the same type of discontinuity always occurs in identical circumstances. In addition to the primary structure elements, larger structure elements are also formed by the aggregation of numbers of primary elements. In such structure aggregates, the area of the particles actually touching becomes smaller in relation to the total mass the larger the number of primary structure elements composing the aggregate, and in consequence the solidity and resistance of the structure decreases very rapidly the larger the secondary structure elements. These colloidal structures are destroyed by chemical and mechanical forces in exactly the same way as crystalline structures, and are reformed in the same way. There is a concentration region where the formation of a colloidal structure is at its optimum, which is generally found in the region of small dispersion and in the neighbourhood of the turbidity conditions. By suitably choosing the concentration relationships, it is possible to follow the formation of the colloidal structure microscopically right up to the macroscopic structure. J. F. S.

Colloid-Chemical Phenomena in the Tyrosinase Reaction. Hugo Haehn (*Kolloid Zeitsch.*, 1921, **29**, 125—130; cf. this vol., ii, 528).—The author has investigated the nature of the variously coloured melanin obtained in the tyrosinase reaction. In the ordinary course of the reaction, the melanin passes through a series of colours, red, brown, violet, blue, and black. It is shown that the ferment tyrosinase consists of two parts, the enzyme, α-tyrosinase, and an inorganic salt. Neither the enzyme nor the inorganic salt alone will effect the reaction, but a mixture of the enzyme and an inorganic salt (calcium chloride, zinc sulphate, cadmium sulphate, and many others) effects the reaction, although not always is the scheme of colours passed through, but the black product is obtained in every case. A number of experiments tend to show that the essential difference between the red and black melanin is a difference in the degree of dispersion. This cannot be definitely proved until the constitution of melanin is established, but both substances undergo similar changes, for example, with hydrosulphite, and are thus shown at least to be similar. Both substances are negatively charged. The tyrosinase reaction is shown to be composed of two parts, (*a*) a biochemical, and (*b*) a colloid-chemical reaction. In the former, the α-tyrosinase breaks up the tyrosine molecule and in the presence of the inorganic salt builds up the red melanin molecule. This is followed by the second reaction, in which coagulation changes the finely disperse red phase into the coarsely disperse black phase, after which precipitation occurs. J. F. S.

New Physico-chemical Law. The Law of Variability. JOSEPH ERLICH (*Ann. Chim. Analyt.*, 1921, **3**, 246—250).—A theoretical paper in which the variability of a system is discussed. It is shown that it is often not simple to fix the variability from considerations of the phase rule, this involving as it does the arbitrary quantity, "number of components." The present paper gives a method of fixing the variability of a system in all cases where the concentrations are only susceptible of change in relation to one and the same phase, the rest remaining invariable. It is shown that where gases constitute one of the phases of a system, the variability is equal to the number of gases, and in systems in solution where there is no gaseous phase, the variability is equal to the number of substances less one. J. F. S.

Physico-chemical Study of the Double Decomposition, $(NH_4)_2B_4O_7+2NaCl \rightleftarrows Na_2B_4O_7+2NH_4Cl$, for the Technical Preparation of Borax. U. SBORGI and C. FRANCO (*Gazzetta*, 1921, **51**, ii, 1—57).—The authors first discuss the theoretical considerations relating to systems containing reciprocal pairs of salts in solution and the methods of representing graphically their solubilities in water. The system corresponding with the equation $(NH_4)_2B_4O_7+2NaCl \rightleftarrows Na_2B_4O_7+2NH_4Cl$ has been investigated at 0°, 10°, and 25°, it being found that the pair stable in a temperature zone below 25° is the one containing borax; the data obtained are expressed in accordance with Jänecke's formula. The solubility diagrams exhibit two invariant points, at constant pressure and constant temperature, the solid phase consisting of (I) $NaCl+Na_2B_4O_7,10H_2O+NH_4Cl$, or (II) $(NH_4)_2B_4O_7,4H_2O+Na_2B_4O_7,10H_2O+NH_4Cl$; with the first there corresponds a congruent, and with the second an incongruent solution, the so-called transformation interval lying in the temperature zone considered.

The yield of borax is calculated for each point of the solubility diagram, the highest yields corresponding with that portion of the curve joining points (I) and (II) (above) nearest to the latter.

T. H. P.

Deduction of the Laws of Chemical Statics from the Theorem of Virtual Work. R. ARIANO (*Gazzetta*, 1921, **51**, ii, 95—108).—In this mathematical paper it is shown to be possible to enunciate, as a single principle, the theorem of virtual work, which serves as the starting-point for the exact treatment of all problems of equilibrium. The co-ordination of chemical and mechanical statics thus produced aids in the deduction, from the comparison between various phenomena, of the general laws governing a large number of natural phenomena. Various applications of the principle are developed. T. H. P.

Reaction in the Dark between Chlorine and Trichlorobromomethane. ALEXANDRA VON RANKE (*Zeitsch. Elektrochem.*, 1921, **27**, 365—367.; cf. Noddack, this vol., ii, 568).—The reaction between chlorine and trichlorobromomethane has been examined at 100°. The reacting substances were sealed in bulbs in such a way

that the chlorine was entirely dissolved and no gas space left. Other experiments were carried out in which the chlorobromomethane was diluted with 3—255 volumes of carbon tetrachloride. The reactions were allowed to proceed until a definite brown tint was reached, when the amount of bromine set free was estimated spectrophotometrically. The velocity of the bromine separation decreases with the dilution. From this it follows that the primary reaction is not due to the chlorine atoms. The velocity constant for the reaction is given by the equation $K_2=[Br_2]/[Cl_2].[CCl_3Br].t$, from which the course of the reaction is regarded as follows: (i) $Cl_2+CCl_3Br=CCl_4+Cl+Br$, (ii) $Cl+CCl_3Br=CCl_4+Br$, (iii) $Br+Br=Br_2$. J. F. S.

The Rate of Hydrolysis of Ethyl Orthoformate. ANTON SKRABAL and OTTO RINGER (*Monatsh.*, 1921, **42**, 9—46).—The hydrolysis of ethyl orthoformate takes place in accordance with the two separable equations: $CH(OEt)_3+H_2O \longrightarrow H{\cdot}CO_2Et+2EtOH$ and $H{\cdot}CO_2Et+H_2O \longrightarrow H{\cdot}CO_2H+EtOH$. The second reaction is the ordinary ester hydrolysis; its already determined velocities in an acid and alkaline medium have been measured again, and the values $k_s=0{\cdot}192$ and $k_a=1080$ at 25° are confirmed. The first reaction is shown to proceed too slowly in alkaline solution to permit measurement, so that ethyl orthoformate is not noticeably hydrolysed by water alone or under the influence of hydroxyl ions. On the other hand, in strongly acid solution it proceeds with extreme rapidity. The formation of formic acid from the ortho-ester in solutions of mineral acids must therefore occur at a rate equal to that of the acid hydrolysis of ethyl formate; this is shown to be the case. The rapid reaction can be measured in the presence of a hydrogen buffer solution of primary and secondary phosphate, the course of the change being followed by measurement of the ethyl formate present after known intervals of time. The latter is only very slightly attacked under the experimental conditions adopted. It is thus possible to isolate the process of hydrolysis of ortho-ester to formic ester and to measure its rate in a medium of constant acidity. The results show that it is a reaction of the first order and that a proportionality exists between the velocity and the hydrogen-ion concentration. On the basis $[H^{\cdot}]=1$, the velocity constant $k=70{,}000$, which is unusually high in comparison with other acid hydrolysis constants.

In connexion with his experimental results and the similar investigations of Verkade (A., 1914, ii, 256; 1916, ii, 234, 607; 1918, ii, 103), the hydrolysis of the three types, ROR′, AOR, AOA′ (in which R=alkyl, A=acyl), is discussed and it is shown that ethyl orthoformate belongs to the ether type. H. W.

Hydrolysis of Ethyl Oxamate. ANTON SKRABAL and GRETE MUHRY (*Monatsh.*, 1921, **42**, 47—62).—The methods used are similar to those adopted with oxalic esters (A., 1917, ii, 250; 1919, ii, 144). The hydrolysis in alkaline solution is effected in the presence of disodium phosphate: $CO_2R{\cdot}CO{\cdot}NH_2+Na_2HPO_4+H_2O=CO_2Na{\cdot}CO{\cdot}NH_2+NaH_2PO_4+R{\cdot}OH$. The course of the change is

followed by titration of the unaffected disodium to monosodium phosphate by *N*/10-hydrochloric acid in the presence of methyl-orange. The velocity constant for [OH′]=1 at 25° is found to be 48,000 for the methyl and 22,000 for the ethyl ester. The hydrolysis is also measured in *N*/10-hydrochloric acid solution, and is followed by titration with *N*/10-ammonia solution in the presence of alizarine; for [H˙]=1, the velocity constants are calculated to be 0·0020 and 0·0015 for the methyl and ethyl esters respectively.

The communication concludes with a long theoretical discussion, based on the results obtained by the author with oxalic esters, of the influence of change in one group on the reactivity of the second group in the case of symmetrical di-esters. It is frequently observed that such alterations which do not affect the second group with regard to one particular type of action are also without influence in all other kinds of action. H. W.

Catalytic Actions at Solid Surfaces. VI. Surface Area and Specific Nature of a Catalyst: Two Independent Factors controlling the Resultant Activity. E. F. ARMSTRONG and T. P. HILDITCH (*Proc. Roy. Soc.*, 1921, [*A*], **99**, 490—495; cf. A., 1920, ii, 608).—The apparent volume of reduced nickel prepared in various circumstances has been determined and compared with the catalytic activity of the preparation. It is shown that nickel hydroxide reduced on kieselguhr gives a much larger volume than the same substance or the fused oxide reduced in the absence of kieselguhr, and that this product is very much more active than the nickel produced from the other sources. The rate of reduction of nickel oxide is also studied. The time–reduction curves show an inflexion point which depends on the physical state of the oxide and the temperature. The authors consider that the more rapid initial reduction represents the production of metallic nickel from the surface of the oxide particles, the slower subsequent rate corresponding with the reduction of a denser central core of oxide: such partly reduced oxide represents a supported catalyst as in the case of reduced nickel on kieselguhr, and its superior activity is to be attributed to the same cause as that of the kieselguhr-nickel oxide. The relation of the activity of a supported nickel catalyst to its reduced metal content has been ascertained in the case of the hydrogenation of cotton-seed oil at 180°. The results show that the variations in the catalytic power of reduced nickel are to be ascribed to the different surface areas of the free nickel exposed, and do not require for their interpretation the assumption of the presence of any catalyst (such as an oxide) other than metallic nickel. J. F. S.

The Stability of Atoms. (SIR) ERNEST RUTHERFORD (*Proc. Physical Soc.*, 1921, **33**, 389—394).—A lecture delivered before the Physical Society of London on June 10, 1921. A. A. E.

Constitution and Stability of Atom Nuclei. WILLIAM D. HARKINS (*Phil. Mag.*, 1921, [vi], **42**, 305—339).—Seven experimental correlations between the stability and composition of atomic nuclei are summarised. Three methods of classifying

isotopes are: (1) into four classes according as the number of electrons and protons in the nucleus is odd or even; (2) into isotopic numbers, varying from −1 for hydrogen and the lower isotope of helium, 0 for the most abundant atomic species, up to 54 for uranium; (3) according to series relationships. The problem of nuclear stability in relation to the above is discussed. There is a marked periodicity in the variation of abundance, atomic stability, and a number of functions which express the composition of atomic nuclei. The most important relations which can be utilised in the prediction of isotopes are that the ratio of electrons to protons in the nucleus is never less than 0·5 for stable atoms, and the number of isotopes is in general considerably greater for elements of even than for elements of odd atomic number. J. R. P.

Atomic Dimensions. MARIANO PIERUCCI (*Nuovo Cim.*, 1921, [vi], **22**, 189—198).—The author considers the question whether the numbers calculated by Bragg (A., 1920, ii, 538) as the true radii of the atoms are multiples of one and the same length, which he terms the "elementary length" (A., 1920, ii, 300). Division of the atomic volume by the Avogadro number gives what may be termed briefly the "volume of the atom," and from this, together with the assumption that the atom is spherical and that at the absolute zero the packing is as close as possible, the value of the "elementary length" is calculated to lie between 0·036 and 0·039 Å. The available data are insufficient to decide the above question, but from the table given by Bragg (*loc. cit.*) it is evident that the calculated atomic radii group themselves round the atomic radii of the inert gases, and that the atomic radii for neon, argon, krypton, and xenon are related almost exactly as the numbers, $4\Delta : 6\Delta : 7\Delta : 8\Delta$, Δ having the value 0·34 Å.; the latter is almost exactly nine times the "elementary length."

For the four inert gases for which Bragg has calculated the atomic diameter, D_A (*loc. cit.*), the latter (in Å.) is related to the absolute melting point, T_f, in accordance with the simple expression, $T_f = 79D_A - 81$. Bragg does not give the value of the atomic diameter of helium, but taking its absolute melting point as 0—2° Abs., the expression just given leads to the value 1·025—1·05 Å. for such atomic diameter. Since $3\Delta = 1{\cdot}01$ Å., the conclusion seems justified that the atomic radii of helium, neon, argon, krypton, and xenon are related as 3 : 4 : 6 : 7 : 8. T. H. P.

The Elements regarded as Compounds of the First Order. S. H. C. BRIGGS (*Phil. Mag.*, 1921, [vi], **42**, 448—456).—If the elements are regarded as compounds of the atomic kernels (that is, the residues when all the electrons in the outer shell are removed) and electrons, their reactions with each other are precisely analogous to the reactions between binary compounds; for example, (*a*) $K^kE + Cl^kE_7 = K^k[Cl^kE_8]$ (where E=electron) and (*b*) $2KCl + PtCl_4 = K_2[PtCl_6]$. There is no essential difference between the forces holding together atoms in a compound and those holding the kernels and electrons in an atom. There are only two elements, ***proton***

and *electron.* The atomic kernels are compound radicles of proton and electron, some of which combine with electron to give strongly polar substances like alkali metals and others non-polar substances such as neon (cf. $NH_4+Cl=NH_4Cl$ and $C_6H_5+Cl=C_6H_5Cl$). The chemical elements are true compounds of the first order, Werner's "compounds of the first order" are really of the second order, and substances such as potassium platinichloride of the third order. Co-ordination is involved in all valency phenomena. J. R. P.

Encounters between Non-spherical Gaseous Molecules. A. O. RANKINE (*Proc. Physical Soc.*, 1921, **33**, 362—376).—An extension of the author's previous work (this vol., ii, 489) on molecular dimensions and structure derived from the combined data of the kinetic theory of gases and of *X*-ray crystal measurements. In the present paper, non-spherical molecules built up of atoms of unequal sizes are considered; the paper considers all cases of diatomic molecules and special cases of polyatomic molecules.

J. F. S.

Valency Theory of G. Lewis and the Asymmetry of the Water Molecule. EUSTACE J. CUY (*Zeitsch. Elektrochem.*, 1921, **27**, 371—373).—A theoretical paper in which, on the basis of the views put forward by Lewis (A., 1916, ii, 310) in connexion with the statical atom, the author has developed formulæ for the molecules of water, hydrogen sulphide, and ammonia. It is shown that in water the linking angle is approximately the same as that between carbon bonds. The distance between the oxygen nucleus and the hydrogen nuclei is the same in both cases, but is different from that between the two hydrogen nuclei. The well-defined dipolar character of water is expressed by the above, for two hydrogen atoms lie in one half of the tetrahedron and two electron pairs in the other half. The asymmetric nature of the water molecule is confirmed by the molecular heat, $6R/2$, whereas a symmetrical structure would demand $5R/2$. An asymmetric structure favours association more than a symmetrical structure. The cases of ammonia and hydrogen sulphide can be considered in the same way.

J. F. S.

Inorganic Chemistry.

Reversible Reactions of Hydrogen and Carbon Monoxide on the Metallic Oxides. GEORGES CHAUDRON (*Ann. chim.*, 1921, [ix], **16**, 221—281).—A more detailed account of work already published (cf. A., 1914, ii, 721; 1920, ii, 182, 379; this vol., ii, 178). W. G.

Iodine Monochloride. E. FOURNEAU and E. DONARD (*Bull. Sci. Pharmacol.*, 1920, **27**, 561—566).—The addition of sodium

chloride stabilises solutions of iodine monochloride to the same degree as does hydrogen chloride; it does not inhibit the first phase of iodine trichloride decomposition which yields iodine monochloride. A method for the estimation of iodine monochloride, based on the facts that, unlike free iodine, the monochloride is scarcely soluble in chloroform, whereas it is very soluble in ethyl ether, and that it liberates iodine from potassium iodide, yields results of moderate accuracy. CHEMICAL ABSTRACTS.

Density, Refractivity Relationship and Dispersion of Gaseous Nitrogen at its Boiling Point. ERICH GEROLD (*Ann. Physik*, 1921, [iv], **65**, 82—96).—The density of gaseous nitrogen at the boiling point has been determined by the displacement method. Six determinations are recorded at temperatures 77·68—77·77° Abs., and from the mean the value $d_g=0{\cdot}0044973\pm17\times10^{-7}$ at 741·10 mm. and 77·75° Abs., is calculated. The refractive index of gaseous and liquid nitrogen at the boiling point has also been determined. In the case of the gas, the following values have been obtained at 752·32 mm. and 77·97° Abs.; $\lambda=643{\cdot}9$, $n=1{\cdot}0010779$, $\lambda=546{\cdot}1$, $n=1{\cdot}0010847$, $\lambda=435{\cdot}8$, $n=1{\cdot}0011007$, whilst the liquid at 745·12 mm. and 77·12° Abs. gave the values $\lambda=656{\cdot}3$, $n=1{\cdot}19844$; $\lambda=579{\cdot}1$, $n=1{\cdot}19876$, $\lambda=546{\cdot}1$, $n=1{\cdot}19918$, $\lambda=435{\cdot}8$, $n=1{\cdot}20142$; $\lambda=404{\cdot}7$, $n=1{\cdot}20258$. Wiener has replaced the figure 2 of the Lorenz-Lorentz formula by the symbol u, which he terms the form number. The value of u is exactly 2 for substances the molecules of which are exactly spherical, but is greater than 2 if the form diverges from the spherical. In the present case, the value of u has been calculated from the formula $(n_L^2-1)/(n_L^2+u)/d_L=(n_g^2-1)/(n_g^2+u)\cdot d_g$, in which d_L and d_g are the densities of the liquid and gas at the boiling point and n_L and n_g the respective refractive indices, and the mean value $u=2{\cdot}16\pm0{\cdot}04$ obtained. This value indicates that the nitrogen molecule behaves as though it were nearly spherical, but since for red light $u=2{\cdot}04$, it behaves as though more nearly spherical than in the case of violet light, where $u=2{\cdot}26$. Consequently it follows that the electron which is active in the absorption of light of short wave-length has a greater orbit than that operative in the absorption of light of longer wave-length.

J. F. S.

The Attack of Metals by Sulphuric–Nitric Acid Mixtures. PAUL PASCAL [with GARNIER and LABOURRASSE] (*Bull. Soc. chim.*, 1921, [iv], **29**, 701—709).—An examination of the action of mixtures of sulphuric and nitric acids varying in proportion and concentration on aluminium, steel, and lead, the results being expressed as loss in weight of the metal in grams per square metre in twenty-four hours, a large excess of the acid being used, and the temperature being maintained at 16—18° for the aluminium and steel and 19—21° for the lead. The addition of sulphuric acid to nitric acid facilitates the attack of aluminium. With nitric acid alone, the presence of ammonium nitrate slightly increases the attack of the metal. For all the varying proportions of sulphuric and nitric

acids, there is a concentration corresponding with between 10 and 20% of water at which the resistance of steel is a maximum.

W. G.

Fusion of Carbon. SIEGMAR MÜNCH (*Zeitsch. Elektrochem.*, 1921, **27**, 367—368).—On strongly heating graphite rods by means of a powerful electric current, they are shown to soften and become plastic and eventually to melt. A graphite rod 50 mm.^{2} in cross section and 5 cm. long, when subjected to a current of 800 amperes at 25 volts, melts and may be welded to a large graphite block which serves as a carrier for the current used. The plastic graphite may be bent or compressed so that its diameter is doubled. An apparatus is described by means of which large quantities of graphite may be melted. The cooled molten graphite has a metallic lustre. The literature dealing with previous attempts to melt carbon is considered. (See following abstract.) J. F. S.

[**Fusion of Carbon**]. EUGEN RYSCHKEWITSCH (*Zeitsch. Elektrochem.*, 1921, **27**, 368—369; cf. preceding abstract).—A criticism of statements made by Münch in connexion with the author's experiments on the fusion of carbon. It is pointed out that the large current (800 amperes) found necessary by Münch to fuse carbon was probably due to the experiment being carried out in the open air, where the cooling was very great. This also accounts for the very few drops of molten carbon obtained, since graphite burns in air at 900°. J. F. S.

The Action of Alkaline Hydrogen Peroxide on Silver [Nitrate] Solution and the Behaviour of Silver towards Dilute Sulphuric Acid. E. SALKOWSKI (*J. pr. Chem.*, 1921, **102**, 194—208).—When silver nitrate solution is added gradually to a dilute solution of hydrogen peroxide containing a little potassium or sodium hydroxide, a black precipitate is formed initially which becomes greyer as more of the silver nitrate solution is added, and ultimately resembles elementary silver. Analysis, however, shows it to be a mixture of silver and silver oxide in which the proportion of the former increases with increasing quantities of hydrogen peroxide in the solution. Silver peroxide is not present. Analysis is effected by treating the product with boiling dilute sulphuric acid (100 grams of acid made up to a litre with water), which almost completely dissolves the oxide, but only attacks metallic silver to a very slight extent. (The reason of this slight solvent action could not be elucidated; it does not appear to depend on the presence of atmospheric oxygen, nor does sulphur dioxide seem to be liberated during the process.) The black colour of the precipitate is therefore due to the presence of a black modification of silver which can be prepared in a very stable condition by adding a solution of silver nitrate (3%, 10 c.c.) to a solution of dextrose (10%, 20 c.c.) and sodium hydroxide (*d* 1·16, 5 c.c.).

Silver peroxide may be detected in the following manner. A small portion of the substance is heated to boiling for a short time

with an aqueous solution of an aliphatic amino-acid, preferably glycine or alanine, which must not be used in too small quantity. The formation of a silver mirror indicates the presence of silver peroxide, whereas silver oxide does not show this reaction. Also, when silver peroxide is covered with nitric acid (d 1·2) a dark brown solution is produced which becomes lighter and finally colourless when heated, but retains its colour for days at the laboratory temperature. The second test appears to be somewhat more sensitive than the first. H. W.

Decomposition of Ammonium Carbonate with Calcium Sulphate. BERNHARD NEUMANN [with WALTER GELLENDIEN] (*Zeitsch. angew. Chem.*, 1921, **34**, 441—442, 445—447).—The author has investigated theoretically the reaction between ammonium carbonate and calcium sulphate. The latter substance forms two hydrates and exists in three anhydrous forms. Although there is uncertainty as to absolute solubilities, it is known that the dihydrate, gypsum, has a maximum solubility at about 38° and that the most soluble form is the semihydrate, for which the figure may reach 1%. The dihydrate has a negative heat of solution, the other forms have positive heats.

It is calculated that the yield of ammonium sulphate with 0·25N-ammonium carbonate solution should be 99·97%, the value rising slightly with increasing concentration. The yield at any temperature is calculated from the equation

$$\log_e K_1/K_2 = 2{\cdot}303 \log K_1/K_2 = -Q/R \, . \, T_2 - T_1/T_1 - T_2$$

where Q is the heat of solution of calcium sulphate, that of the carbonate being negligible. It is shown that the influence of temperature on the reaction equilibrium is slight.

Experiments showed that in all cases conversion was almost complete in an hour, but complete equilibrium was only reached in from fifteen to twenty hours. The maximum yields obtained were: for the dihydrate 85%, for the semihydrate and gypsum heated at 200—300° 92%, and for anhydrite 90%. In all cases the yields increased slightly with the concentration of the ammonium carbonate solution. The yield with the dihydrate increased with the temperature up to 38°, and then remained constant. Owing to the decomposition of ammonium carbonate at 58°, heating beyond this point is useless. Change of temperature had no appreciable effect on the reaction with ignited gypsum. The discrepancy between these results and the theoretical yields of more than 99% was explained by determining the solubility curve of calcium sulphate in ammonium sulphate solutions of different strengths; the existence of a double salt, $(NH_4)_2SO_4,CaSO_4,H_2O$, was indicated. The suggestion that the reaction might be further complicated by an appreciable solubility of calcium carbonate in ammonium carbonate solution was investigated and disproved. C. I.

Decomposition of Calcium Sulphate by Ammonium Hydroxide. BERNHARD NEUMANN [with GERTRUD KOTYGA] (*Zeitsch. angew. Chem.*, 1921, **34**, 457—459).—Equilibrium conditions in the reaction $2NH_4{\cdot}OH + CaSO_4 \rightleftarrows (NH_4)_2SO_4 + Ca(OH)_2$

were investigated. If $Lm_1\alpha$ and $2Lm_1\beta$ are the concentrations of the ions [SO_4] and [OH], the ratio of the molecular solubilities of the products [Ca]·[SO_4] and [Ca]·[OH]^2 is $Lm_1^2\alpha^2/4Lm_1^3\beta^3$, which ratio, k, is found to be 3821 at 18°. If x and y are the molecular ionic concentrations and a is the normality of the ammonia solution $x/y^2=k$ and $2x+y=a$, k being known, y is determined in terms of a and the yield for any concentration of ammonia thus obtained. It varies from 6·6% with N/100-ammonium hydroxide to 88% with 10N-solution. The variation with temperature may also be calculated; up to 37° the yield falls. The reaction was experimentally investigated by shaking two flasks, one containing gypsum and water and the other gypsum and ammonium hydroxide solution, and estimating the sulphate in solution in each from time to time. For N/10-ammonium hydroxide, the yield was 33%, in agreement with the calculation, but with increasing concentration it fell rapidly instead of rising, with N-solution being only 3%. The reaction is thus useless for practical purposes. The reverse reaction, $(NH_4)_2SO_4+Ca(OH)_2=(NH_4)OH+CaSO_4$, gave a 96% decomposition with 5N-ammonium sulphate solution, falling to 53% with N/4-solution. The latter is again in agreement with calculation; the figures for stronger solutions are in excess of those to be expected. All these divergencies occurring in all solutions except the weakest, are due to the varying solubilities of calcium sulphate in ammonium sulphate solutions caused by the formation of the double salt. C. I.

The System Potassium Sulphate–Glucinum Sulphate–Water at 25°. HUBERT THOMAS STANLEY BRITTON and ARTHUR JOHN ALLMAND (T., 1921, **119**, 1463—1470).

Phosphorescent Zinc Sulphide. RUDOLF TOMASCHEK (*Ann. Physik*, 1921, [iv], **65**, 189—215).—A method is described whereby phosphorescent zinc sulphide may be prepared so that a product of uniform and reproducible properties for the examination of the phosphorescence of this substance is now for the first time obtained. Using this method, zinc sulphide containing respectively manganese and copper as phosphorogens has been prepared, and the properties and the phosphorescence bands of these substances have been examined. The bands have been compared with those previously obtained with ill-defined material. The phosphorescence phenomena of zinc sulphide containing respectively bismuth, lead, silver, uranium, nickel, and cobalt have been examined, and a number of new phosphorescence bands found and measured. The whole of the bands are considered and the series nature pointed out.
J. F. S.

Corrosion of certain Complex Brasses in Sea-water. I. L. BELLADEN (*Gazzetta*, 1921, **51**, ii, 144—159).—Of three samples of delta metal examined, that showing the greatest resistance to the corrosive action of sea-water contains the highest proportions of lead, manganese, and iron, as well as a small percentage of

nickel, which is lacking in the other two. [Cf. *J. Soc. Chem. Ind.*, 1921, 701A.] T. H. P.

The Theory of Smelting. III. Equilibria between Pairs of Metals and Sulphur. The System, Copper–Antimony–Sulphur. W. GUERTLER and KARL LEO MEISSNER (*Metal u. Erz*, 1921, **18**, 410—415).—It is shown that sulphur cannot exist in equilibrium with copper antimonide and that a reaction occurs with the formation of cuprous sulphide. $2Cu_3Sb+S=2Cu_2Sb+Cu_2S$; $Cu_2Sb+S=Cu_2S+Sb$. Cuprous sulphide melted with either antimony or the antimonides yields stable mixtures, but no ternary compounds are formed. Copper and antimony trisulphides react according to the equations: $12Cu+Sb_2S_3=3Cu_2S+2Cu_3Sb$; $10Cu+Sb_2S_3=3Cu_2S+2Cu_2Sb$; $6Cu+Sb_2S_3=3Cu_2S+2Sb$. The rectangle $Cu-Sb-Sb_2S_3-Cu_2S$ is subdivided into six triangles by the five quasi-binary intersections, Cu_2S-Cu_3Sb; Cu_2S-Cu_2Sb; Cu_2S-Sb; Cu_3SbS_3-Sb; and $CuSbS_2-Sb$. Two independent mixture gaps occur in the system, which are probably dependent on similar gaps in the binary systems $Cu-Cu_2S$ and $Sb-Sb_2S_3$. J. F. S.

Electrolysis of Cerium Salts in Aqueous Solutions. A. B. SCHIØTZ (*Tidskrift Kem.*, 1920, **17**, 213—215, 228—232).—The double chlorides of cerium and iron were electrolysed in an aqueous solution in presence of lactic acid, the rotating, dome-shaped, lead-plated platinum cathode being inverted over the anode chamber; the latter consisted of a glass tube with a helical row of openings, the platinum wire anode being wound round the tube through which the anode liquid was drained. The product consisted of a cerium–iron alloy containing 59·4 to 67% of cerium, and was probably free from oxides. CHEMICAL ABSTRACTS.

Aluminium. E. RATTENBURY HODGES (*Chem. News*, 1921, **123**, 141).—Aluminium foil is unattacked by boiling strong acetic acid even after eighteen days in the absence of air; on exposure to the air for a week, traces of aluminium were found to have dissolved. If, however, a few drops of hydrogen peroxide are added to strong acetic acid in which a strip of the metal is immersed, the whole dissolves at 15° within thirty hours. Slightly warmed aluminium foil reacts with bromine with brilliant incandescence, the mixture evolving a heavy grey vapour of anhydrous bromide and leaving a brown, granular residue which soon deliquesces to a liquid from which colourless tabular crystals may be obtained on evaporation. Whilst citric and tartaric acids have no effect on the metal, oxalic acid dissolves it very slowly in the cold but more readily on heating, the solution, on evaporation, yielding an oily-looking colloidal film which deliquesces in moist air. Strong phosphoric acid readily dissolves aluminium foil, whereas it has no action on tin foil; this difference serves to distinguish between the two elements. A. R. P.

Equilibrium Diagram of the System, Silicon–Iron. TAKEJIRÔ MURAKAMI (*Sci. Rep. Tôhoku Imp. Univ.*, 1921, **10**, 79—92).—Silicon–iron alloys containing up to 32·7% of silicon

have been prepared and subjected to magnetic, thermal, and microanalysis and the equilibrium diagram has been constructed. It is shown that there are two compounds, Fe_3Si_2 and FeSi, in the system. The former is magnetic with its critical point at 90°, whilst the latter is non-magnetic. An alloy corresponding with the formula Fe_2Si (20% Si) is neither a compound nor a saturated solid solution, as stated by Tammann and Guertler (A., 1906, ii, 32). The compound Fe_3Si_2 dissolves in iron up to 16% of silicon at ordinary temperatures. The critical point of its solid solution in iron gradually decreases from 790° to 450°, as the silicon content increases from 0 to 16%. As the temperature rises, the solubility increases to 23% of silicon at 1020°. By heating to a temperature above 1100°, the compound Fe_3Si_2 dissociates into iron and FeSi, and in alloys containing more than 23% of silicon, FeSi separates primarily on cooling the melt, and at 1020° Fe_3Si_2 is formed. Photomicrographs of sections of a large number of alloys are appended to the paper. J. F. S.

Mineralogical Chemistry.

The Structure of Humic Acids and Coals. J. MARCUSSON (*Zeitsch. angew. Chem.*, 1921, **34**, 437—438).—The author criticises the assumption of Fischer and Schrader (this vol., ii, 210) that natural humic acids are phenolic in character and contain no furan ring, basing their conclusions on the effects of oxidation under pressure. Lignin, natural humic acids, lignite, and coal yield benzenecarboxylic acids, whilst cellulose and artificial humic acids from carbohydrates yield furancarboxylic acids. Chardet (*Rev. gen. Chim. pure appl*, **17**, 214) has shown, however, that the dry distillation of natural humic acids yields both furan and furfuraldehyde in addition to phenolic compounds. Fischer and Schrader have recently (*Brennstoff-Chem.*, 1921, **2**, 216) obtained furancarboxylic acids as well as benzenecarboxylic acids by the oxidation under pressure of artificial humic acids obtained by treating sugar with strong hydrochloric acid. If humic acids contain a *peri*-difuran ring (this vol., i, 313), this, on decomposition, would yield derivatives of either benzene or furan, according to the experimental conditions. Succindialdehyde is considered to be an intermediate product in the formation of humic acid from furan. An aldehyde acid (Humalsäure), closely related to humic acid, has been recently found in peat, but it is not found in lignite. The *peri*-difuran nucleus exists in coal and lignite, the presence of the bridged oxygen being proved, as with humic acid, by the behaviour with fuming sulphuric acid or with nitric acid, and the formation of double salts with iron chloride and with mercury bromide. The

author concludes that both cellulose and lignin have taken part in the formation of coal. W.

Analytical Chemistry.

Micro-analysis of Gases by the Use of the Pirani Pressure Gauge. Research Staff of the General Electric Co., Ltd. (N. R. Campbell) (*Proc. Physical Soc.*, 1921, **33**, 287—296).—A method of analysis of small quantities of gases is described. The method consists in determining the condensation temperature of each gas consecutively. The gas contained in a side tube of a Pirani gauge is cooled to a temperature sufficient to liquefy the whole mixture, or, if some non-condensible gas is present, until the whole liquefiable portion has been liquefied. The temperature is then slowly raised and pressure-temperature readings are taken. A curve is produced which consists of a number of horizontal lines of constant pressure joined by a number of vertical, or nearly vertical, lines of constant temperature. The vertical temperature lines give the condensation temperatures of the individual constituents. The length of the ordinates serves as a relative measure of the quantity of each constitutent. The total pressure admissible in the determination is 0·2 mm. and measurements may be made down to 0·001 mm. As cooling bath, the authors recommend freezing mercury (—39°), freezing chloroform (—65°), freezing acetone (—95°), freezing ethyl alcohol (—117°), and liquid air (—183°). In actual practice no thermometer is used, but the condensation temperatures of the mixture are compared with the condensation temperatures of the individual gases. To do this a number of gauges are made each containing one pure gas, and these are observed alongside the gauge containing the mixture. The method is very accurate and capable of wide application.

J. F. S.

Losses in Chlorine in the Estimation of Chlorine in Organic Compounds by Incineration and their Prevention. A. Weitzel (*Arb. Reichs-Gesundh.-Amt*, 1920, **52**, 635—649; from *Chem. Zentr.*, 1921, iv, 228).—The ordinary methods for the estimation of chlorine in organic compounds by incineration are examined. The most suitable is the author's wet method (A., 1917, ii, 501). By observing certain precautions, however, chlorine can be estimated in the ash of organic compounds. Accurate results may be obtained if the substance is mixed with lime and water to form a cream, which is then dried and incinerated; or the substance may be incinerated after mixing with sodium carbonate and potassium nitrate. G. W. R.

The Estimation of Bromine in Salt Waters. P. Lebeau and M. Picon (*Bull. Soc. chim.*, 1921, [iv], **29**, 739—743).—A preliminary approximate estimation is made by titrating 1 c.c. of

the water with chlorine water containing 0·5 gram of chlorine per litre until decoloration just commences. The volume required represents approximately double the amount of chlorine required to displace all the bromine present as bromide.

A volume of water containing about 0·1 gram of bromine is placed in a separating funnel, 5 c.c. of 10% hydrochloric acid are added, and the calculated quantity of chlorine water containing 5 grams of chlorine per litre is run in. The liberated bromine is extracted with 15 c.c. of chloroform, and the chloroform extract is run into 10 c.c. of 10% potassium iodide solution in a stoppered bottle. The liquid in the separating funnel is again extracted with chloroform after the addition of 0·3—0·5 c.c. of chlorine water. This is repeated until the chloroform is colourless. The iodine liberated by the addition of the chloroform extracts to the potassium iodide is titrated with *N*/10-sodium thiosulphate. To obtain satisfactory results by this method the use of excess of chlorine water must be avoided, and the volume of water containing 0·1 gram of bromine as bromide should not exceed 25 c.c., a preliminary evaporation being conducted if necessary. W. G.

Volumetric Estimation of Sulphurous Acid in Organic Substances by Distillation. VICTOR FROBOESE (*Arb. Reichs-Gesundh.-Amt*, 1920, **52**, 657—669; from *Chem. Zentr.*, 1921, iv, 225).—The method proposed is a modification of that of Haase (A., 1882, 773). The sulphur dioxide obtained by distillation is collected in a standard solution of sodium hydrogen carbonate in the presence of hydrogen peroxide, whereby the sulphite is oxidised to sulphate. The excess of sodium hydrogen carbonate is titrated with hydrochloric acid, using methyl-orange as indicator. The sulphate formed may be estimated gravimetrically by precipitation with barium chloride as a control. The water used for the dilution of the liquid from which the sulphur dioxide is distilled must be free from oxygen. A long reflux condenser is desirable in order to prevent volatile organic acids from passing over. The method is applicable to the estimation of sulphites in cellulose-sulphite liquors, wine, dried fruit, and gelatin. G. W. R.

Volumetric Method for the Estimation of Acids and Bases which yield Insoluble Salts. G. BRUHNS (*Zeitsch. anal. Chem.*, 1921, **60**, 224—229).—A method described previously by Bucherer (A., 1920, ii, 702) yielded trustworthy results in the estimation of sulphates in crude sugars, molasses, etc.; the separation of the precipitated barium sulphate is facilitated by the addition of a small quantity of aluminium hydroxide, which, when kept for two days, becomes particularly insoluble in acid solutions. W. P. S.

Modification of the Dumas Method, and Application of the Kjeldahl Method to the Estimation of Nitrogen in Nitro-naphthalenes. PAUL H. M.-P. BRINTON, F. N. SCHERTZ, W. G. CROCKETT, and P. P. MERKEL (*J. Ind. Eng. Chem.*, 1921, **13**, 636—639).—In the modified Dumas method described, the carbon dioxide used is generated from dilute sulphuric acid and sodium

carbonate solution which are admitted to a large container filled originally with water; the gas is passed through two measuring bottles, one of which is filled with water, and the discharge of this from one bottle to the other, alternately, indicates the volume of carbon dioxide passing. The gas is then conducted, by a suitable arrangement of tubes and three-way taps, to the combustion tube, where the substance is burnt with copper oxide. The nitrogen is collected over sodium hydroxide solution, three nitrometers being used in connexion with each other; the combustion gases pass upwards through the first nitrometer, causing a circulation of sodium hydroxide solution from this to the others, and the liquid collecting in the levelling bulbs is returned to that of the first nitrometer as required. One of the nitrometers is provided with a water-jacket, and serves as the measuring vessel for the nitrogen.

To estimate nitrogen in nitronaphthalenes by the Kjeldahl method, about 0·5 gram of the substance is heated with 30 c.c. of sulphuric acid and 2 grams of salicylic acid for two hours on a water-bath, the mixture is then cooled, 2 grams of zinc dust are added, and after about eighteen hours the mixture is heated, first at 70°, and afterwards over a small burner, until all visible action ceases. One gram of mercuric oxide is next added, the mixture boiled for one hour, cooled, 7·5 grams of potassium sulphate are added, and the boiling is continued for a further period of one hour. The ammonia is then estimated by distillation in the usual way. The results obtained are lower than those found by the Dumas method, the difference increasing with the nitrogen content. For instance, 13·74% of nitrogen found by the Kjeldahl method corresponds with 14·33% by the Dumas method, and 15·48% with 16·85%. W. P. S.

Micro-estimation of Nitrogen and its Biological Applications. M. Polonovski and C. Vallée (*J. Pharm. Chim.*, 1921, [vii], **24**, 129—134).—To estimate the total nitrogen, a portion of the substance containing from 1 to 2 mg. of nitrogen is heated for fifteen minutes in a test-tube with 1 c.c. of sulphuric acid and 1 gram of potassium sulphate. The mixture is then diluted with 6 c.c. of water, and the tube is connected with a small absorption vessel containing *N*/50-sulphuric acid; a current of air, heated previously by passing it through warm water containing a small quantity of sulphuric acid, is aspirated through the whole apparatus. After twenty minutes, the absorption apparatus is disconnected and the excess of sulphuric acid is titrated. Another portion of 3 c.c. of the original solution is then treated with 2 drops of acetic acid and a small quantity of sodium chloride, the mixture is heated at 90°, cooled, submitted to centrifugal action, and the nitrogen determined in an aliquot portion of the clear liquid; the difference between the two estimations gives the amount of nitrogen present as coagulable albumin. W. P. S.

Removal of Protein from Body Fluids for the Purpose of Simultaneous Estimation of Many Constituents. Genko Mukai (*Biochem. J.*, 1921, **15**, 516—520).—For the estimation of

non-protein nitrogen in serum, etc., the author boils the substance with sodium acetate and acetic acid, and removes the last traces of protein with talcum. The results are usually very slightly higher than those of the Folin-Denis method (A., 1912, ii, 703). G. B.

Estimation of Sodium Nitrite. F. MUHLERT (*Zeitsch. angew. Chem.*, 1921, **34**, 448).—In the estimation of nitrites by the diazotisation method, *o*-aminobenzoic acid may be advantageously substituted for sulphanilic acid. The end point is sharp, the diazo-compound stable, and the reagent can be easily obtained in a pure state. C. I.

Source of Error in the Estimation of Nitrate-Nitrogen by Ulsch's Method. F. MACH and F. SINDLINGER (*Zeitsch. anal. Chem.*, 1921, **60**, 235—238).—Traces of sulphide in the reduced iron used for the reduction of nitrates according to Ulsch's method cause the results obtained to be much too low. For instance, a potassium nitrate solution containing 13·86% of nitrogen yielded only 12·90% when the reduction was carried out with iron containing 0·03% of sulphur as sulphide. Each new quantity of reduced iron should, therefore, be tested against a pure nitrate before it is used for actual estimations. W. P. S.

Estimation of Phosphorus in Iron, Steel, Ores, and Slags. H. KINDER (*Zeitsch. anal. Chem.*, 1921, **60**, 241—257).—A report of a critical examination of the molybdate method for the estimation of phosphorus, with particular reference to the influence of other elements. In the estimation of phosphoric acid in slags, the magnesium pyrophosphate method yielded results which were slightly higher (0·1 to 0·3%) than those yielded by the molybdate method. W. P. S.

Double Arsenic Tubes. GEORG LOCKEMANN (*Zeitsch. angew. Chem.*, 1921, **34**, 396).—To economise in glass tubing, a piece of hard glass tubing is drawn out so that three portions of the original diameter of the tube are connected by capillaries, the whole being in one piece; the tube is used in conjunction with the ordinary Marsh apparatus. The first arsenic mirror is obtained in the first capillary; for the next estimation, the second wide portion and capillary are used, and the tube is then reversed and used in a similar manner for two further estimations. W. P. S.

Micro-estimation of Carbon Monoxide in Blood. MAURICE NICLOUX (*Bull. Soc. Chim. Biol.*, 1921, **3**, 286—296).—A micro-modification of the author's method (A., 1921, i, 204) for the estimation of carbon monoxide in blood is described; 2 to 5 c.c. of blood are used for an estimation, and it is claimed that the method is simple and accurate to within 2%. Notes are given on the application of the method to the estimation of the capacity of the blood for absorbing carbon monoxide, and of the amount of the latter present in blood in cases of poisoning. C. R. H.

Estimation of Metals in Alloys of Known Qualitative Composition. K. SCHMIDT (*Chem. Zeit.*, 1921, **45**, 825—826).—From a knowledge of the atomic weights and specific gravities of the constituent metals of a binary or ternary alloy, together with the weight and volume of the alloy under examination, it is possible to calculate the percentage composition. The author has obtained formulæ for binary and ternary alloys involving in the first case the use of four constants based on the atomic weights and specific gravities of the constituent elements and these have been calculated for all the more important commercial binary alloys. [Cf. *J. Soc. Chem. Ind.*, 1921, Oct.] A. R. P.

Estimation of Alkali Hydroxide and Carbonate in presence of Cyanide and Ferrocyanide. F. MUHLERT (*Zeitsch. angew. Chem.*, 1921, **34**, 447).—A method for the estimation of alkali in potassium or sodium cyanide consists in titrating the cyanide with silver solution, removing the turbidity formed at the end point with a drop of cyanide solution, and then titrating with normal acid until the turbidity reappears. The method is accurate if most of the alkali is present as hydroxide. In presence of other weak acids, for example, formic acid, this method cannot be used, neither does Clenell's method give good results. The best procedure is as follows. The cyanide is first titrated with silver solution, and the same quantity of solution added to another sample. The resulting solution after filtration can now be used for whatever alkalimetrical estimations are desired. If great accuracy is not required, the solution need not be filtered. If ferrocyanide is present, the solution may be titrated directly with normal acid and methyl-orange. The cyanide having been previously estimated, the alkali is obtained by difference. C. I.

Rapid Estimation of Silver in Alloys by a Modified Silver Chloride Method. SAUERLAND (*Chem. Zeit.*, 1921, **45**, 735—736).—About 0·5 gram of the alloy is treated with 10 c.c. of nitric acid, *d* 1·4, a small quantity of water is added, the mixture boiled, diluted to 80 c.c., again boiled, and, after five minutes, the insoluble matter (gold, tin, antimony) is collected on a filter and washed. A slight excess of hydrochloric acid is added, drop by drop, to the filtrate, the latter is then boiled, and the silver chloride is collected on a filter. The moist filter is then supported on the mouth of a small crucible, the upper part of the paper is wrapped round the end of a porcelain tube connected with a supply of coal gas, and the crucible is heated by a burner; the filter-paper chars, and after a time falls into the crucible, the silver chloride meanwhile being reduced by the coal-gas introduced through the porcelain tube. The reduction is completed by the incineration of the charred paper, and the resulting metallic silver is weighed. W. P. S.

Simple Technique for the Estimation of Calcium and Magnesium in Small Amounts of Serum. BENJAMIN KRAMER and FREDERICK F. TISDALL (*J. Biol. Chem.*, 1921, **47**, 475—481).—One or 2 c.c. of serum, diluted with 2 c.c. of water, are mixed with

1 c.c. of saturated ammonium oxalate solution. The precipitate is collected by centrifuging and repeatedly washed in the same way with water and 2% ammonia, and is then titrated with $N/100$-potassium permanganate solution. An aliquot portion of the supernatant fluid of the calcium estimation is precipitated with ammonium phosphate; the ammonium magnesium phosphate is collected in a Gooch crucible and is dissolved in $N/100$-hydrochloric acid. Half the solution, mixed with 2 c.c. of a ferric thiocyanate solution, is compared colorimetrically with standards prepared with known amounts of ammonium magnesium phosphate. The error is $\pm 5\%$ of the calcium and magnesium present. G. B.

Sensitiveness and Applicability of Qualitative Reactions. II. Barium Ions. O. LUTZ (*Zeitsch. anal. Chem.*, 1921, **60**, 209—223; cf. A., 1920, ii, 509).—The following are the minimum quantities of barium which can be detected by various reagents; in each case, 5 c.c. of the barium salt solution were treated with 0·5 c.c. of the reagent and the observation was made after five minutes. Sodium arsenate and ammonium chloride, 1 : 175; potassium ferrocyanide and ammonium chloride, 1 : 430; ammonium oxalate, 1 : 4400; sodium phosphate, 1 : 6200; aniline hydrosilicofluoride, 1 : 6000; ammonium carbonate and ammonia, 1 : 28000; sodium carbonate, 1 : 160000; sodium sulphite, 1 : 160000; ammonium chromate, 1 : 1200000; sulphuric acid, 1 : 1600000. W. P. S.

Application of Amalgams in Volumetric Analysis. I. Estimation of Molybdenum, Titanium, and Iron. TAMAKI NAKAZONO (*J. Chem. Soc. Japan*, 1921, **42**, 526—537).—About 0·15 gram of the metallic compound is reduced by vigorously shaking with 200 grams of liquid zinc amalgam and 10 c.c. of $2N$-sulphuric acid during 0·5—1 minute in a specially made separating funnel, in which the air is replaced by carbon dioxide. After the reaction is completed, the solution is titrated with standard potassium permanganate solution. The method has been successfully applied to ammonium molybdate, titanic acid, and iron alum. The amalgam is prepared by heating 3 to 4 grams of zinc with 100 grams of mercury and some dilute sulphuric acid on a water-bath for one hour; the product is thoroughly washed with water and separated from solid residue. The amalgam may be used many times without loss of activity and the effect of some impurities in the metal on the accuracy is almost negligible. K. K.

Dimethylglyoxime Reactions of Iron and Cobalt. WILH. VAUBEL (*Zeitsch. öffentl. Chem.*, 1921, **27**, 163—164).—A deep red coloration is obtained when solutions of ferrous salts are treated with dimethylglyoxime solution and ammonia; the reaction is also given by ferric salts if a trace of ammonium sulphide is added before the ammonia. This coloration is distinct from that given by nickel salts, and there is no formation of a precipitate. Cobalt solutions give a yellowish-brown coloration with dimethylglyoxime

and ammonia; if ammonium sulphide is added before the ammonia, the coloration produced is bluish-violet to deep red.] W. P. S.

Quantitative Separation of Tin and Antimony in the Presence of Phosphoric Acid. (MLLE) MOURET and J. BARLOT (*Bull. Soc. chim.*, 1921, [iv], **29**, 743—745).—The tin-antimony alloy is dissolved in aqua regia and the solution evaporated almost to dryness. The residue is taken up with warm concentrated hydrochloric acid and the solution diluted with an equal volume of water. To it is added at least 50 c.c. of an 8—9% solution of crystalline orthophosphoric acid for every 0·01 gram of tin present. The antimony is precipitated as sulphide by hydrogen sulphide at 80—90°, collected on a filter, and the antimony subsequently estimated electrolytically. The filtrate is boiled to remove hydrogen sulphide and the tin is precipitated by the addition of cupferron and estimated in the usual manner. W. G.

Estimation of Titanium in Iron and Steel. THEODOR DIECKMANN (*Zeitsch. anal. Chem.*, 1921, **60**, 230—234).—One gram of the sample and 1 gram of iron free from vanadium are dissolved separately in dilute nitric acid, the two solutions are evaporated with the addition of sulphuric acid and heated until fumes of sulphuric acid are evolved; after cooling, the residues are boiled with dilute sulphuric acid, silica is separated by filtration, and the filtrates are treated with 10 c.c. of phosphoric acid (*d* 1·3) and a few c.c. of hydrogen peroxide. Standard titanium sulphate solution is added to the solution containing the iron free from vanadium until the colour of this solution is brought to the same intensity as that of the solution containing the sample under examination. W. P. S.

Estimation of Nickel and Copper on Nickel-plated or Copper-plated Iron Articles. H. KOELSCH (*Zeitsch. anal. Chem.*, 1921, **60**, 240—241).—The nickel or copper may be dissolved by immersing the metal in a hot sodium nitrite solution acidified with acetic acid; the iron does not dissolve as long as nitrite ions are present (see D.R.-P. 319855 and 330131). W. P. S.

Estimation of Vanadium in Steels and Iron Alloys. LUIGI ROLLA and MARIO NUTI (*Giorn. Chim. Ind. Appl.*, 1921, **3**, 287).—Vanadium may be precipitated quantitatively from a solution containing about 1% of free hydrochloric or sulphuric acid by means of 4% aqueous "cupferron" solution in the cold, the precipitate being washed with 2% hydrochloric or sulphuric acid solution to which 2% of the 4% cupferron solution has been added, dried at about 70°, calcined and weighed as vanadium pentoxide. Iron and chromium may be easily separated from vanadium by precipitation by means of boiling sodium hydroxide solution. In the case of ferrovanadium, about 0·5 gram is treated with six times its weight of sodium peroxide in an iron crucible, the silica being removed after filtration and the iron as described above, and the

11.

vanadium precipitated with cupferron. With steel, the hydrochloric acid solution is used, this being freed from silica and tungsten by filtration and from iron by treatment with ether; the liquid is boiled with sodium carbonate and filtered, the filtrate being treated with either lead acetate or lead nitrate and acetic acid. The lead vanadate thus precipitated is dissolved in dilute hydrochloric acid and evaporated with concentrated sulphuric acid. The residue is taken up in water and the vanadium precipitated in the filtrate by means of cupferron. T. H. P.

Denigès's Test for the Detection and Estimation of Methyl Alcohol in the Presence of Ethyl Alcohol. ROBERT M. CHAPIN (*J. Ind. Eng. Chem.*, 1921, **13**, 543—545).—A modification of Denigès's method is described, the new procedure rendering the test more trustworthy. The alcohol is diluted until it contains 1% of total alcohols (solution *A*); 10 c.c. of this solution are mixed with 10 c.c. of 4% ethyl alcohol and diluted to 50 c.c. (solution *B*), and 10 c.c. of the latter solution are also mixed with 10 c.c. of 4% ethyl alcohol and diluted to 50 c.c. (solution *C*). Four c.c. of each of these solutions are placed in separate Nessler cylinders, and standards containing 1, 2, 3, etc., c.c. of 0·04% methyl alcohol solution, and 1 c.c. of 4% ethyl alcohol solution are prepared in other cylinders, the volumes in each case being diluted to 4 c.c. Each cylinder then receives the addition of 1 c.c. of phosphoric acid (1 : 5) solution and 2 c.c. of 3% potassium permanganate solution; after thirty minutes, 1 c.c. of 10% oxalic acid solution is added to each, followed, after two minutes, by 1 c.c. of concentrated sulphuric acid and 5 c.c. of Schiff-Elvove reagent. The colorations obtained are compared after the lapse of one hour. Acetone does not interfere with the method, but glycerol, carbohydrates, formic acid, acetic acid, and phenol, if present, should be removed by distilling the alcohol with the addition of sodium hydroxide; formaldehyde and terpenes are removed by treatment with silver nitrate and sodium hydroxide followed by distillation. W. P. S.

Possible Improvements in the Ebulliometric Estimation of Alcohol in Wines. UGO PRATOLONGO (*Giorn. Chim. Ind. Appl.*, 1921, **3**, 290—293).—The construction of the scale, and the construction, control, and use of the ebulliometer, are discussed [see *J. Soc. Chem. Ind.*, 1921, 711A]. T. H. P.

Application of the Determination of Miscibility Temperature to Alcoholimetry. H. ROSSET (*Ann. Chim. Analyt.*, 1921, [ii], **3**, 235—239).—The miscibility temperature (the point at which the surface of separation of certain mixtures disappears) may be used to estimate the alcoholic strength of a liquid. For instance, when 5 c.c. of an alcoholic solution are mixed with 30 c.c. of pure acetone and 5 c.c. of standard light petroleum (b. p. 210—225°), the miscibility temperature varies from −5·5° for 90% alcohol to +27·6° for 65% alcohol. For lower alcoholic strengths,

a mixture of 50 c.c. of acetone and 5 c.c. of light petroleum is used, 5 c.c. of the alcoholic solution being added; in this case, the miscibility temperature varies from $-1{\cdot}0°$ for 65% alcohol to $+23{\cdot}0°$ for 28% alcohol. W. P. S.

Concentration and Purification of Alcoholic Fermentation Liquids. I. Distillation in Steam of certain Alcohols. JOSEPH REILLY and WILFRED J. HICKINBOTTOM (*Sci. Proc. Roy. Dubl. Soc.*, 1921, **16**, 233—247).—The distillation constants of methyl, ethyl, propyl, *n*-butyl, *iso*butyl and *sec.*-butyl, and *iso*amyl alcohols have been investigated under experimental conditions similar to those employed in the recent work on fatty acids (A., 1919, ii, 528). Dilute solutions of the alcohols were distilled at constant volume, in most cases 200 c.c., water being introduced into the distillation flask at the same rate as distillation proceeded. The alcohol content of successive fractions of distillate was estimated from the density and by oxidation. The distillation constant, $A=1/v \log a/a-x$, in which a is the initial amount of alcohol in the flask and x the amount in the total distillate after a volume v has distilled, was found to increase with the molecular weight of the alcohols and to be greater for *sec.*- and *iso*-butyl alcohols than for *n*-butyl alcohol. For a given alcohol it was, as anticipated from general considerations, inversely proportional to the initial volume of liquid in the flask, and it also varied, although to a smaller extent, with the concentration of the alcohol, increasing as the concentration diminished. This variation of the constant with concentration confirms earlier work by Sorel (A., 1893, ii, 347) and Gröning. Several possible causes of these variations are discussed, and it is suggested that they may be accounted for by variations in the "mass of water per c.c. of distillate." J. H. L.

Estimation of Cresol by the Phenol Reagent of Folin and Denis. ROBERT M. CHAPIN (*J. Biol. Chem.*, 1921, **47**, 309—314).—Apart from other defects (cf., for example, Gortner and Holm, A., 1920, ii, 643), the estimation of phenols by the colorimetric method of Folin and Denis (A., 1915, ii, 802) suffers from the disadvantage that the phenol reagent gives colours of different intensity with equivalent quantities of different phenols. For the estimation of total cresol in mixtures of cresols of approximately known composition the author therefore introduces the use of empirical factors. The method is applied to the estimation of phenolic preservatives in serums. E. S.

Volumetric Estimation of Aminonaphthol-mono- and di-sulphonic Acids. GIORGIO RENATO LEVI (*Giorn. Chim. Ind. Appl.*, 1921, **3**, 297—302).—The aminonaphtholsulphonic acids may be titrated either with sodium nitrite in an acid solution or with diazo-compounds, comparison of the results obtained in these two ways serving as the best criterion of the purity of these compounds; the difference should be not more than 0·5% for a dry, or 0·2% for a pasty, product. The titration with nitrite is carried out by running $N/5$-sodium nitrite solution into a fresh solution or

suspension of the sulphonic acid containing free mineral acid; excess of the latter causes no appreciable increase in the velocity of diazotisation; the latter is, however, affected by the temperature, which should be to 10—12° at first and 25—30° at the end of the reaction. In the titration with diazo-compounds, the author makes use of either freshly-prepared diazobenzene or recently-titrated *p*-nitrodiazobenzene. In general, these aminonaphthol-sulphonic acids may undergo combination in two different ways, namely, in acid solution in the ortho-position to the amino-group, and in alkaline solution in the ortho-position to the hydroxyl group. Contrary to the statement made in many patent specifications, in acetic acid solution the combination occurs in the ortho-position with respect to the hydroxyl group. The colorations produced by the diazo-compounds of the aminonaphtholsulphonic acids are due to an internal combination, occurring either within a single molecule or between two molecules.

The aminonaphtholmonosulphonic acids examined were: M-acid ($NH_2 : OH : SO_3H = 1 : 5 : 7$), S-acid (1 : 8 : 4), γ-acid (2 : 8 : 6), J-acid (2 : 5 : 7) and R-acid (2 : 3 : 6), and the disulphonic acids: 2S-acid ($NH_2 : OH : SO_3H : SO_3H = 1 : 8 : 2 : 4$), H-acid (1 : 8 : 3 : 6), K-acid (1 : 8 : 4 : 6) and 2R-acid (2 : 8 : 3 : 6). Taking the "nitrite number" as basis, the titration of the diazo-compounds may be effected as follows: M-, 2S-, and 2R-acids with *p*-nitrodiazobenzene in sodium carbonate solution, and J- and R-acids in acetic acid solution; S-, γ-, and K-acids in acetic acid solution, and H-acid in sodium carbonate solution, with diazobenzene. Qualitative characters for the differentiation between the various isomerides are given. T. H. P.

The Estimation of Citronellol by the Formylation Method. ALEXANDER ST. PFAU (*J. pr. Chem.*, 1921, **102**, 276—282).—The estimation of geraniol and citronellol by the formic acid method gives inexact results, in part because a portion of the geraniol undergoes esterification. Even with pure citronellol, however, the method gives uncertain data (cf. Schimmel & Co., A., 1914, i, 67; Simmons, A., 1916, ii, 117). The author's results are irregular and high when 100% acid is used, but low with a weaker acid. It is shown that the action of the acid on citronellol is not a simple process, fractionation of the product under diminished pressure leading to the isolation of citronellyl formate, b. p. 99—100°(corr.)/7 mm., the compound, $OH\cdot CMe_2\cdot[CH_2]_3\cdot CHMe\cdot CH_2\cdot CH_2\cdot O\cdot CHO$, b. p. 129°(corr.)/5 mm., d^{15} 0·9651, $\alpha_D + 1° 46'$, n_D^{15} 1·4488 and the corresponding *di-formate*, $CMe_2(O\cdot CHO)\cdot[CH_2]_3\cdot CHMe\cdot CH_2\cdot CH_2\cdot O\cdot CHO$, a colourless, highly refractive liquid, b. p. 140—141°(corr.)/7 mm., unchanged citronellol and, frequently, a small amount of more volatile liquid, possibly an aliphatic or a cyclic terpene. H. W.

Estimation of the Composition of Ternary Mixtures: Ether–Water–Alcohol. LOUIS DESVERGNES (*Mon. Sci.*, 1921, **11**, 145—150).—The composition of mixtures of ethyl ether, ethyl alcohol, and water is estimated by determining the quantity of water or of ether required to produce a turbidity, or the quantity

of alcohol required to produce a clear liquid when the mixture is not homogeneous; graphs are given which show the composition corresponding with the quantities of water, etc., added.

W. P. S.

The Estimation of Sugar in Urine. J. C. VAN DER HARST and C. H. KOERS (*Pharm. Weekblad*, 1921, **58**, 1230—1232).—The fermentation apparatus devised by Stephan under the name hydrosaccharometer has been found to be more trustworthy than Wagner's apparatus and to give results as accurate as those obtained by the polarimeter where the sugar content is not below about 1%. The Causse-Bonnans method has been re-examined, and again found unsatisfactory. S. I. L.

Volumetric Estimation of Phenylhydrazine and its Application to the Estimation of Pentosans and Pentoses. ARTHUR ROBERT LING and DINSHAW RATTONJI NANJI (*Biochem. J.*, 1921, **15**, 466—468).—The carbohydrate is distilled in the usual way with 12% hydrochloric acid; an aliquot portion of the distillate is neutralised, slightly acidified, mixed with a standard aqueous phenylhydrazine solution (about 2%), kept at 50—55° for twenty minutes, and filtered; an aliquot part of the filtrate, containing excess of phenylhydrazine, is mixed with excess of standard iodine solution, and titrated with thiosulphate. The reaction is represented by the equation $PhNH{\cdot}NH_2+2I_2=3HI+C_6H_5I+N_2$. The results agree closely with those obtained by the phloroglucide method. G. B.

Identification of Ouabain and Strophanthin, and a New Test to Distinguish between the two Glucosides. A. RICHAUD (*J. Pharm. Chim.*, 1921, **24**, 161—166).—To distinguish between ouabain and strophanthin in actual pharmaceutical practice where often only a milligram or so of the substances is available, the following differential characteristics may be utilised: Ouabain is soluble in 150 parts of water at 15°, whilst strophanthin dissolves in 40—43 parts at that temperature. The solution of the former is perfectly clear and colourless, and does not give a persistent froth on shaking. Strophanthin solutions, on the other hand, are inclined to be yellow, and are not perfectly transparent. They have a very pronounced bitter taste, and give a persistent froth on agitation. Under the microscope, ouabain appears as a pure white powder or small, rectangular tabular crystals, whilst strophanthin appears usually as a dirty or yellowish-white, amorphous powder, or crystallised in leaflets often grouped round a centre. Finally, a new colour reaction is proposed, which consists in warming in a water-bath at 60° or 70° in a test-tube 5 c.c. of concentrated hydrochloric acid, a few crystals of resorcinol, and a trace of the glucoside. Ouabain gives no coloration, and strophanthin a rose colour, the test depending, of course, on the difference in the sugars generated by the hydrolysis of the two glucosides. G. F. M.

Detection of Oxalic and Citric Acids. M. POLONOVSKI (*J. Pharm. Chim.*, 1921, **24**, 167—168).—The usual method for the

detection of oxalic acid is simplified by the following procedure. The acid radicles are converted into sodium salts, and a saturated solution of calcium fluoride is added to the alkaline filtrate acidified with acetic acid. In presence of oxalic acid, calcium oxalate is precipitated under these conditions, its solubility in water at 15° being 0·00056%, whilst that of calcium fluoride is 0·05%. In the absence of fluorides from the original substance, a saturated solution of calcium sulphate may advantageously be substituted for the fluoride solution.

Citric acid may readily be detected in presence of any of the common organic acids by adding to the original solution potassium permanganate solution until the pink colour persists, then 1 c.c. of bromine water, and warming to decolorisation. In presence of citric acid, a precipitate of perbromoacetone is formed, but still more characteristic is the evolution of irritant vapours which attack the eyes, so that the least trace cannot possibly escape detection. G. F. M.

Detection and Estimation of Lævulic Acid in Foods. L. Grünhut (*Z. Unters. Nahr. Genussm.*, 1921, **41**, 261—279).—Lævulic acid occurs in certain carbohydrate foods, and is usually accompanied by formic, acetic, and lactic acids; it may be identified by the red coloration which it yields with sodium nitroprusside in alkaline or acetic acid solution. A method for the estimation of lævulic acid depends on its oxidation to acetic acid by means of potassium dichromate and sulphuric acid; the resulting acetic acid is distilled and titrated. Formic acid under the same conditions is oxidised to carbon dioxide; if the amount of acetic acid found in the distillate is in excess of that calculated from the quantity of dichromate reduced (after allowing for the formic acid as estimated separately by the mercuric chloride method), the presence of free acetic acid in the sample is indicated. Lactic acid is also oxidised by dichromate to acetic acid. In the case of a sample containing all the four acids mentioned, the procedure adopted is to acidify the substance with phosphoric acid, extract the organic acids with ether (a quantity of sodium hydroxide is placed in the extraction flask to prevent volatilisation of the formic acid with the ether), then extract the ethereal solution with dilute sodium hydroxide solution and evaporate the united aqueous extracts to dryness. The dry residue is dissolved in a definite volume of water, the organic acids are liberated, and the solution is submitted to a simple distillation. The distillate contains the whole of the acetic acid, the greater part of the formic acid, a small quantity of lævulic acid and no lactic acid; the residual solution in the flask will contain the greater part of the lævulic acid, the remainder of the formic acid, the whole of the lactic acid, and no acetic acid. The two solutions are analysed separately as described. W. P. S.

Detection and Estimation of Salicylic Acid in Wine. W. Fresenius and L. Grünhüt (*Zeitsch. anal. Chem.*, 1921, **60**, 257—266).—Fifty c.c. of the wine are acidified with sulphuric acid,

extracted with a mixture of ether and light petroleum, the extract is evaporated, and the residue tested with ferric chloride. To estimate the salicylic acid, 500 c.c. of the wine are boiled under a reflux apparatus for one hour with the addition of sodium hydroxide solution, the mixture is then cooled, acidified with sulphuric acid, and extracted with ether–light petroleum mixture. The ethereal solution is evaporated with the addition of a small quantity of water, the residual aqueous solution diluted to a definite volume, and used for the colorimetric estimation of the acid by the ferric chloride method. W. P. S.

Estimation of Salicylates and Phenol. W. O. EMERY (*J Ind. Eng. Chem.*, 1921, **13**, 538—539).—A method for the estimation of phenol and salicylates, particularly salol (phenyl salicylate), depends on the formation of a red, amorphous compound, di-iodo-phenylene oxide, when phenol or salicylic acid is treated with iodine in the presence of sodium carbonate: $2PhOH+6I_2+4Na_2CO_3=2C_6H_2OI_2+8NaI+4CO_2+4H_2O$, and $2C_6H_4(OH)\cdot CO_2H+6I_2+4Na_2CO_3=2C_6H_2OI_2+8NaI+6CO_2+4H_2O$. To estimate salol in admixture with acetanilide, phenacetin, and caffeine, a portion of the sample containing about 0·1 gram of salol is extracted with chloroform, the chloroform solution is evaporated, and the residue obtained treated with 10 c.c. of 1% sodium hydroxide solution and heated in a reflux apparatus at such a rate that it boils in two minutes; three successive quantities of 10 c.c., 30 c.c., and 50 c.c. respectively of water are then added, the mixture being boiled after each addition. One gram of sodium carbonate is added with the last quantity of water. An excess (55 to 60 c.c.) of *N*/5-iodine is then added to the boiling solution, the flask is removed from the condenser, a further 1 gram of sodium carbonate is introduced, and the mixture boiled gently for about twenty minutes. If phenacetin is present, the quantity of iodine solution mentioned should be increased by 5 c.c. for each 0·1 gram of phenacetin supposed to be in the mixture. The precipitate formed is collected, washed with 200 c.c. of hot water, dried at 100°, and weighed; the weight found is multiplied by 0·3113 to obtain the corresponding quantity of salol. W. P. S.

Estimation of the Saponification Number, Iodine–Bromine Number and Bromine-substitution Number [of Fats and Waxes]. E. SCHULEK (*Pharm. Zentr.-h.*, 1921, **62**, 391–395).—The use of propyl alcohol, as proposed by Winkler (A., 1911, ii, 550) is recommended in the estimation of the saponification number, since by the use of this solvent even waxes are saponified completely in a short time. In the case of the iodine–bromine number, the results obtained are the higher the longer the time of contact of the fat or oil with the reagent, particularly in the case of linseed oil, croton oil, and lanolin. The reaction in the estimation of the bromine-substitution number is practically complete after two hours' contact. W. P. S.

Colour Reactions of some Nitro-substances. O. RUDOLPH (*Zeitsch. anal. Chem.*, 1921, **60**, 239—240).—The following colorations are obtained when about 1 milligram of the substance is dissolved in 10 c.c. of alcohol or acetone and then treated with 2 c.c. of dilute sodium hydroxide solution or ammonia :

	Alcohol solution.		Acetone solution.	
	With sodium hydroxide.	With ammonia.	With sodium hydroxide.	With ammonia.
o-Dinitrobenzein	colourless	colourless	colourless	colourless
m-Dinitrobenzene............	"	"	intense reddish-violet	pink to purple
p-Dinitrobenzene	"	no characteristic colour	intense yellow	yellow
1 : 3 : 5-Trinitrobenzene ...	yellowish-red	yellowish-red	blood-red	blood-red
2 : 4-Dinitrotoluene	deep blue	colourless	deep blue	colourless
2 : 6-Dinitrotoluene	colourless	"	faint pink	"
2 : 4 : 6-Trinitrotoluene ...	deep yellowish-red	bright red	purplish-red	light red
1 : 8-Dinitronaphthalein ...	yellowish-red	red	yellowish-red	red

W. P. S.

Assay of Aconitine. A. R. L. DOHME (*Amer. J. Pharm.*, 1921, **93**, 426—429).—A physiological method is described and recommended for the valuation of aconite and its preparations, since the ordinary chemical method of extracting the total alkaloids does not differentiate between the amount of aconitine, benzoylaconine, and aconine present, and there appears to be no method available for their separation. Aconitine is about three hundred times as toxic as benzoylaconine and four thousand times as toxic as aconine. In the case of the fluid extract, 1 c.c. is diluted to 10 c.c. with 50% alcohol, and small quantities of this solution, diluted to a volume of 1·5 c.c. with normal saline solution are injected into the subcutaneous tissues of the abdomens of guinea-pigs of about 350 grams body weight. The lethal dose is taken to be the smallest quantity which will kill within twenty-four hours. Approximately 0·00000005 gram per gram of guinea-pig is the lethal dose of aconitine. W. P. S.

Colorimetric Estimation of Carnosine. WINIFRED MARY CLIFFORD (*Biochem. J.*, 1921, **15**, 400—407).—A modification of Koessler and Hanke's colorimetric method for estimating iminazole derivatives (A., 1920, ii, 67). The minced tissue is extracted with a known volume of water at 60—90°. The aqueous extract is then treated with metaphosphoric acid and filtered. An aliquot portion of the filtrate is neutralised to litmus and the depth of colour produced on admixture with sodium carbonate and *p*-diazobenzenesulphonic acid determined colorimetrically in a Duboscq colorimeter. Parallel estimations agree to 0·05 mm. S. S. Z.

Estimation of Acetanilide. A. RECLAIRE (*Perf. Ess. Oil Rec.*, 1921, **12**, 280).—A method, sufficiently accurate for technical purposes, for the estimation of acetanilide, particularly for acetanilide used as an adulterant in artificial musk preparations, is carried

out as follows: About 1·5 grams of the substance are boiled in an acetylation flask with 50 c.c. of 20% hydrochloric acid for fifteen minutes. The volume is then made up to 500 c.c., and to 25 c.c. an excess of a standard potassium bromide–bromate solution and 5 c.c. of strong hydrochloric acid are added. Tribromoaniline is precipitated and the excess of bromine estimated by potassium iodide and sodium thiosulphate in the usual way. One c.c. of $N/10$-thiosulphate equals 0·00225 gram of acetanilide. G. F. M.

A Colour Reaction for Carbamide. VICTOR ARREGUINE and EDUARDO D. GARCÍA (*Anal. Asoc. Quím. Argentina*, 1921, **9**, 183—191).—The colour reactions for carbamide are discussed. The reaction proposed by the authors consists in adding resorcinol and hydrochloric acid to an aqueous solution of the substance under examination and boiling for about one minute. After cooling and dilution with water, the liquid is shaken with ether. The ethereal layer is coloured pink to red, according to the amount of carbamide present. Further colour changes in the ethereal layer are observed on addition of ammonia solution. One milligram of carbamide may be detected by this test, which is also given to a less degree by guanidine and substances giving carbamide under the conditions of experiment. The reaction would appear to be characteristic for the group $=C(NH_2)_2$. It is not applicable to the quantitative estimation of carbamide. G. W. R.

Gasometric Estimation of Urea in Urine. RAYMOND L. STEHLE (*J. Biol. Chem.*, 1921, **47**, 13—17).—The hypobromite method gives results which agree with those obtained by the urease method (A., 1914, ii, 822) if the estimation is carried out in a vacuum after the removal of ammonium salts by means of permutite (cf. Youngburg, this vol., ii, 358). E. S.

Estimation of Urea, Ammonia, and Amino-acids in Urine after Precipitation of the Ammonia. PHILIBERT (*J. Pharm. Chim.*, 1921, [vii], **24**, 49—58. See also A., 1919, ii, 374).—Ammonia is precipitated as ammonium magnesium phosphate and separated by filtration; the filtrate is then treated with basic lead acetate, again filtered, and the urea estimated by the hypobromite method. Another portion of the urine, after the ammonia has been removed, is neutralised towards phenolphthalein, formaldehyde solution is added, and the mixture titrated with standard alkali solution. The results obtained are expressed in terms of nitrogen or of ammonia. W. P. S.

Estimation of Dicyanodiamide and Urea in Fertilisers. ERLING JOHNSON (*J. Ind. Eng. Chem.*, 1921, **13**, 533—535).—A volumetric method proposed for the estimation of dicyanodiamide depends on the formation of the complex silver picrate dicyanoguanidine. Five grams of the sample are shaken for three hours with 450 c.c. of water and 5 c.c. of acetic acid, the mixture is then diluted to 500 c.c., filtered, and 100 c.c. of the filtrate are treated

with 5 c.c. of 20% nitric acid and 20 c.c. of sodium picrate solution (7·5 grams of picric acid neutralised with sodium carbonate and diluted to 100 c.c.; this solution is used at 40° to prevent crystallisation of the salt). The mixture is then cooled in ice-water and a slight excess of silver nitrate solution (7·582 grams per litre) is added and, after fifteen minutes, the whole is diluted to 200 c.c. and filtered. Five c.c. of 20% nitric acid and 2 c.c. of 5% ferric sulphate solution are added to 100 c.c. of the filtrate and the excess of silver is titrated with standardised thiocyanate solution. Each 1 c.c. of the silver nitrate solution is equivalent to 1% of dicyanodiamide-nitrogen. The estimation of urea is based on the formation of urea oxalate; 5 grams of the sample are shaken with 100 c.c. of amyl alcohol, the solution is filtered, 50 c.c. of the filtrate are mixed with an equal volume of ether, and the urea is precipitated by the addition of 25 c.c. of a 10% solution of anhydrous oxalic acid in amyl alcohol. After thirty minutes, the precipitate is collected on a filter, washed twice with a mixture of equal volumes of amyl alcohol and ether, once with ether alone, dried under reduced pressure, and weighed. The precipitate contains 57·01% of urea.
W. P. S.

Reaction for the Micro-chemical Detection of "Chinosol" or 8-Hydroxyquinoline Salts. C. Griebel (*Pharm. Zentr.-h.*, 1921, **62**, 452—456).—A 2% solution of "chinosol" (8-hydroxyquinoline sulphate), when treated with a drop of potassium ferrocyanide solution, yields a bright green, crystalline precipitate, the colour changing within a few minutes to orange-red. The precipitate is formed more slowly from dilute solutions, and is not given when the concentration of the solution is less than 0·5%. With potassium ferricyanide, 8-hydroxyquinoline sulphate solution yields a yellow, crystalline precipitate. W. P. S.

Estimation of Pyramidone (4-Dimethylamino-1-phenyl-2 : 3-dimethyl-5-pyrazolone) in Presence of Antipyrine (1-Phenyl-2 : 3-dimethyl-5-pyrazolone) and Aspirin (o-Acetoxybenzoic Acid). E. Oliveri-Mandalà and E. Calderaro (*Gazzetta*, 1921, **51**, i, 324—328).—Pyramidone may be estimated in presence of antipyrine and aspirin by taking advantage of the fact that the former, but not the latter, yields dimethylamine when boiled with concentrated potassium hydroxide solution (1 : 1); the amine is collected in a known volume of standard acid and its amount determined by titration: 1 gram of pyramidone is found to correspond with 8·50 c.c. of seminormal sulphuric acid, the theoretical number being 8·64 c.c.

When titrated with seminormal hydrochloric acid in presence of methyl-orange, 2 grams of pyramidone correspond with 16 c.c. of the acid and 0·9 gram of aspirin with 1 c.c. of the acid. Hence, the percentage (A) of aspirin in a mixture of the two compounds is given by the formula $A=9(16{\cdot}6-x)$, where x denotes the number of c.c. of the seminormal acid required to neutralise 2 grams of the

mixture; then $100-A$ gives the percentage of pyramidone. [See, further, *J. Soc. Chem. Ind.*, 1921, 600A.] T. H. P.

Estimation of Veronal in Urine and Human Organs. L. VAN ITALLIE and A. J. STEENHAUER (*Pharm. Weekblad*, 1921, **58**, 1062—1068).—Ethyl acetate is preferable to ethyl ether for extracting veronal from urine, the solubility being 1 : 8·9 in the former, and 1 : 18·7 in the latter. When the extract is purified with charcoal, low yields are obtained owing to adsorption. Treatment of the urine with lead acetate or basic lead acetate effects precipitation of some of its constituents and prevents emulsification during the extraction; by treatment of the extract with potassium permanganate, a quantitative yield of pure veronal is obtained. The method is as follows: 100 c.c. of urine are treated with 10 c.c. of lead acetate (or basic lead acetate) solution, and filtered. The filtrate is evaporated to 25 c.c. and acidified with acetic acid. It is then extracted with twice its volume of ethyl acetate, filtered, and evaporated; the residue is dissolved in 10 c.c. of boiling water, with addition of 5 c.c. of dilute sulphuric acid, and $N/10$-potassium permanganate solution added until the supernatant liquid is colourless. The manganese oxide formed is decomposed with a few drops of hydrogen peroxide, the liquid is shaken with twice its volume of ethyl acetate, filtered, evaporated, and the residue dried at 100°. With suitable modification this method is applicable also to the estimation of veronal in various organs. W. J. W.

The Colorimetric Estimation of Tyrosine and the Phenolic Number of Proteins. PIERRE THOMAS (*Bull. Soc. Chim. Biol.*, 1921, **3**, 197—216).—In the estimation of tyrosine in proteins by the colorimetric method of Folin and Denis (A., 1912, ii, 1012) the presence of tryptophan, scatole, indole, and reducing reagents vitiates the results; hence the method is untrustworthy and must be rejected (compare Abderhalden and Fuchs, A., 1913, i, 409; Folin and Denis, A., 1913, i, 915). The author suggests the characterisation of proteins by means of their phenolic numbers, the latter being defined as the numbers, calculated in percentages of tyrosine, which represent the phenolic constituents of the hydrolysates. For the estimation of the phenolic number a weighed portion of the protein is hydrolysed with 25% sulphuric acid, filtered from humin, neutralised with barium hydroxide, acidified with nitric acid, and filtered. Just sufficient mercuric nitrate is then added to an aliquot part of the filtrate to precipitate the tryptophan. After decolorisation, if necessary, by addition of a small quantity of animal charcoal, the colour produced by the addition of 2 c.c. of Millon's reagent to 10 c.c. of the filtered solution is compared with a tyrosine standard. The results of a number of estimations are given. E. S.

Some Corollaries of the Laws of Hydrolysis by Enzymes. H. COLIN (*Bull. Soc. Chim. Biol.*, 1921, **3**, 263—272).—Deductions are made from the laws which govern hydrolysis by enzymes and

are illustrated by examples of the hydrolysis of various sugars. The author is able to detect the presence of sucrose in specimens of other sugars, to obtain a quantitative idea of the amount of enzyme present in a given preparation, and to determine the relative molecular weights of various sugars which are hydrolysed by the same enzyme. C. R. H.

A Colour Reaction Common to Antiscorbutic Extracts and to Quinol. N. BEZSSONOFF (*Compt. rend.*, 1921, **173**, 466—468).—A modified form of the Folin-Denis phenol reagent, prepared by adding its own volume of *N*-sulphuric acid to a solution containing 100 grams of sodium tungstate, 20 grams of phosphomolybdic acid, and 16·6 c.c. of concentrated phosphoric acid per litre, is found to give a blue coloration with plant extracts known to possess antiscorbutic properties and no colour, or at least not a blue colour, with extracts devoid of such properties. It is possible that the action is not due to the antiscorbutic substance itself, but to some polyphenol easily detached from it in solution. Of the numerous phenols examined, quinol was the only one to give the blue colour with this reagent.

When evaporated at 40°, the reagent gave monoclinic crystals having the composition $17WO_3,MoO_3,P_2O_5,H_2O,21H_2O$. W. G.

Methods for Estimating the Amount of Colloidal Material in Soils. CHARLES J. MOORE, WILLIAM H. FRY, and HOWARD E. MIDDLETON (*J. Ind. Eng. Chem.*, 1921, **13**, 527—530).—Soil was shaken with water, allowed to settle for twenty-four hours, the turbid liquid then decanted, submitted to centrifugal action, and the resulting opalescent liquid filtered through Pasteur-Chamberlain filter tubes. The colloidal substance collected on the tubes was washed and dried at 110°; it consisted essentially of hydrated aluminium silicate and has been named "ultra-clay." Each 1 c.c. of the ultra-clay absorbed 93 c.c. of dry ammonia gas, but lost this property when heated previously at 1130°. A sample of the soil from which the ultra-clay was obtained absorbed 27·7 c.c. of ammonia per 1 c.c., and 1·4 c.c. of ammonia after previous heating at 1130° (this absorption was probably due to substances other than "ultra-clay") and it is therefore calculated that the soil contained 28·3% of colloidal substance. An exactly similar result was obtained by a method depending on the absorption of malachite green from an ammonium oxalate solution. W. P. S.

General and Physical Chemistry.

The Luminosity of Mercury Vapour Distilled from the Arc in a Vacuum. NORMAN H. RICKER (*Physical Rev.*, 1921, **17**, 195—226).—Considerable evidence is offered in support of Child's contention (*Phil. Mag.*, 1913, [vi], **26**, 906) that the afterglow in mercury distilled from an arc is due to a recombination of positive and negative ions. Strutt's work (*Proc. Roy. Soc.*, 1918, **94**, [*A*], 88) was repeated and confirmed and it is shown to be not inconsistent with Child's conclusion (cf. *Phil. Mag.*, 1919, [vi], **37**, 61). The author obtained enhanced luminosity by heating the mercury cathode. The luminous vapour passed through a hollow nickel anode into a heated tube containing two or more grids. On charging one of the grids positively, a current flow as great as 1 ampere at 5 volts could be obtained. The red glow which first filled the tube diminished on both sides of the grid up to a grid voltage of 2, after which it was replaced by a blue glow. The change in colour was found to be caused merely by a relative change in intensity of certain lines in the mercury spectrum. On charging a grid negatively, the luminosity upstream is not diminished even at 300 volts and downstream but slightly. The current is a small part of an ampere and never reaches saturation; so that quenching is far from complete. A jet of mercury vapour sent into the luminous stream serves merely to dilute the light. The vapour velocity was determined by applying a high-frequency voltage to one grid with a stroboscopic wheel so that the luminosity appeared in puffs which could be accurately observed. The velocity was 3740 cm. per sec. Then from the rate of distillation the vapour density was calculated and shown to be essentially constant along the tube. The rate of decay of luminosity was observed with a Nutting polarisation photometer and compared with formulæ derived on three assumptions: (1) that the positive ions emit light spontaneously and not continuously; (2) that the light is produced during recombination of positive and negative ions, and (3) that light is continuously emitted by positive ions. Formula 2 fitted the observed decay better than 1, each having but one arbitrary constant; but formula 3 with two arbitrary constants would fit almost any set of data; so it is impossible to decide in its case. All the facts observed support Child's claim that the light is caused by recombination of ions. CHEMICAL ABSTRACTS.

Vacuum Spark Spectra in the Extreme Ultra-violet of Carbon, Iron, and Nickel. R. A. MILLIKAN, I. S. BOWEN, and R. A. SAWYER (*Astrophys. J.*, 1921, **53**, 150—160; cf. this vol., ii, 3, 363).—By using a specially ruled grating containing 500 to 1100 lines per mm., the intensities and wave-lengths ($\pm 0{\cdot}2$ Å.) of 75 lines due to carbon (λ 360—λ 1931), of 200 lines due to iron (λ 271—λ 2153), and of 75 lines due to nickel (λ 731— λ 1860) have been measured. CHEMICAL ABSTRACTS.

Intensity Differences in Furnace and Arc among the Component Series in Band Spectra. ARTHUR S. KING (*Astrophys. J.*, 1921, **53**, 161—164).—Under high dispersion, the A_1 series of lines in the cyanogen band at λ 3883 is enhanced over the A_2 series in the furnace as compared with their behaviour in the arc. Some new doublets appeared in the furnace. The two series appear to belong to different temperature classes and may be expected to differ in other characteristics. The cyanogen band at λ 4216 showed similar differences between furnace and arc. In the Swan band at λ 5165 the triplet series is enhanced in the furnace spectrum with reference to the adjacent doublet series. The bearing of these data on atomic structure is pointed out. CHEMICAL ABSTRACTS.

Obliteration of the Characteristic Spectra of Metals by certain Gases. GEORGE E. GIBSON and W. ALBERT NOYES, jun. (*J. Amer. Chem. Soc.*, 1921, **43**, 1255—1261).—When sodium chloride is melted below a spark gap in oxygen and sparks are passed they are brilliant yellow in colour and show the *D* lines distinctly, but if the oxygen is displaced by chlorine the spark becomes pale blue and only the merest trace of the *D* line can be observed, and it is further noticed that the spark passes with great difficulty. Similar experiments were made with a number of gases using sodium, thallium, and mercury salts and it was found that of thirty-seven gases and vapours examined twenty-three obliterated the characteristic lines of the salts used. An approximate measure of the sparking potential was also obtained by placing a parallel spark gap outside the apparatus and varying this until the spark just failed to pass across it. Vapours of carbon disulphide, sulphur, carbon tetrachloride, sulphur dichloride, arsenic, iodine, stannic chloride, bromine, chlorine, nitrogen dioxide, boron trichloride, phosphorus trichloride, arsenic trichloride, silicon tetrachloride, titanium tetrachloride, arsenious oxide, sulphur trioxide, acetylene, sulphur dioxide, selenium, phosphorus, hydrogen iodide, and ferric chloride obliterate the characteristic spectrum, whilst nitric oxide, carbon monoxide, hydrogen sulphide, oxygen, nitrogen, hydrogen, carbon dioxide, ammonia, mercury, hydrogen chloride, hydrogen bromide, thallous chloride, and mercuric chloride do not affect the spectrum. The gases which exert the obliterating power have also a high sparking potential, and in the main are the gases which, on Lewis's theory of molecular structure, are to be expected to have the power of combining readily with electrons or to dissociate in the spark into gases of this character. The parallelism between high sparking potential and power to obliterate the spectrum lines is explained on the assumption that the molecules of gases which have these two properties unite with free electrons to form ions of larger mass which are incapable of producing further ionisation. J. F. S.

Induction Spectrum of Rubidium. LOUIS DUNOYER (*Compt. rend.*, 1921, **173**, 472—474).—Using the method previously applied to cæsium (this vol., ii, 529), the author has obtained an induction spectrum of rubidium showing 332 lines between λ=2294 and

$\lambda = 5525$. The principal rays and their intensities are tabulated in the original. Most of the intense rays have been found in the spark spectrum by Exner and Haschek, but some of the rays of the spark spectrum do not appear in the induction spectrum.

W. G.

The Rôle of Electrical Actions in the Emission and Appearance of certain Types of Rays in the Spectrum of Magnesium. A. DE GRAMONT and G. A. HEMSALECH (*Compt. rend.*, 1921, **173**, 505—511).—The authors have extended their work on the appearance of spark rays of lead and tin in the electric arc (cf. *ibid.*, 1921, **173**, 278) to the case of magnesium. Details are given of the variation in the lines produced by changing the conditions under which the spark or arc is maintained. The arc was struck between magnesium electrodes under glycerol, petroleum, and water, and sparks were passed in hydrogen, oxygen, coal gas, and nitrogen. The emission of spark rays by the arc, under liquid layers, is independent of the nature and conductivity of the liquid. The emission of these rays is apparently regulated by electrical forces, and their sudden cessation corresponds with a certain critical value of the electrical forces below which their emission cannot be sustained. The remarkable symmetrical broadening of the spark ray, as well as the broadening towards the red of the rays of the Rydberg series during the first phase of the arc, is a manifestation of the Stark effect.

W. G.

Fine Structure of Band Spectra. E. GEHRCKE and L. C. GLASER (*Ann. Physik.*, 1921, [iv], **65**, 605—608).—The structure of the band spectra of magnesium, mercury, and carbon has been investigated. As source of light, the arcs of the substances in a vacuum were used. The light from the arc fell on a plane parallel plate 5 mm. thick, and the interference bands, in the same manner as employed by Galli and Förstling (*Physikal. Zeitsch.*, 1917, **18**, 155) were projected on the slit of a prism spectrograph. In the case of magnesium, the lines $\lambda\lambda$ 5529 and 4703 were seen very sharply whilst $\lambda\lambda$ 5184, 5173, 5167, and 4352 and the green triplet were found, but these were less sharp. Mercury showed the lines $\lambda\lambda$ 4358, 4348, 4340, 4078, 4047, and three extended series of lines with the limiting line at $\lambda\lambda$ 4396, 4218, and 4017 respectively. Carbon shows the heads of the bands much less sharply than the preceding cases. Interference is, however, shown by the heads of the carbon bands, particularly at $\lambda\lambda$ 4216 and 4197. The distance between two interference maxima corresponds with 0·16 Å.U. in the blue and 0·15 Å.U. in the violet.

J. F. S.

Spectra of Lead Isotopes. T. R. MERTON (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 84—88).—Comparative measurements of the wave-length of the line 4058 Å.U. with ordinary lead and lead from carnotite showed a difference of $0{\cdot}011 \pm 0{\cdot}0008$ A.U. The difference is about two hundred times that expected on Bohr's theory if the

difference is calculated in the same manner as that between the Balmer lines of hydrogen and the enhanced helium lines. J. R. P.

The Variation with Temperature of the Electric-furnace Spectrum of Manganese. ARTHUR S. KING (*Astrophys. J.*, 1921, **53**, 133—143).—The spectrum produced in the tube resistance furnace at 1700°, 2000°, and 2400° was examined from λ 2795 to λ 8200, but no lines were found beyond λ 6500. The relative intensities of the lines in the arc spectrum and in the furnace spectra at the different temperatures are tabulated, and the temperature classification of the lines is given. Some lines were observed at 1560°; the triplet λ 4031 to 4035 was strong and well reversed at this temperature. As with other furnace spectra, the ultra-violet wave-length limit is shorter the higher the temperature. None of Lockyer's enhanced lines occurs in the furnace. The behaviour of various types of lines is given in detail. Of special interest is the triplet at λ 2800, which is always reversed, and the one at λ 4033 the intensity of which depends on the quantity of vapour present. CHEMICAL ABSTRACTS.

Symmetrical Coupled Groups of Lines in the Iron Spectrum. E. GEHRCKE (*Ann. Physik*, 1921, **65**, 640—642).—A theoretical paper in which the author describes a number of regularities in the violet end of the iron spectrum which are visible in the photographs recently published by Glaser (*Ann. Gewerbe u. Bauwesen*, 1921, **88**, 32). It is shown that six groups of lines exist which both with regard to position and intensity of the components are symmetrical about a middle point. These are a group of six lines, with its centre at λ 4221 Å.U., a group of fourteen lines with the centre at λ 4215, a group of six lines with the centre at λ 4193·3, a group of ten lines with the centre at 4195·5, a group of nine lines with the centre at λ 4235, and a group of sixteen lines with the centre at λ 4199·3. These groups are not quite independent of one another, for it is shown that the two extreme components of the first-named group and the left inner component also belong to the second group. Similar coupled symmetrical groups have also been observed in the spectra of tungsten and molybdenum. It is suggested that a Zeeman effect or a Stark effect on account of the magnetic or electric field of the atom itself is responsible for the regularity, which is explicable if one of the twenty-six electrons on the surface of the atom changed its position due to the action of the field. J. F. S.

Influence of Elevated Temperature on the Fluorescence and Absorption Spectra of Iodine Vapour of Constant Density. J. PRINGSHEIM (*Zeitsch. Physik.*, 1921, **5**, 130—138).—The influence of elevated temperatures on the fluorescence and absorption spectra of iodine vapour has been examined. It is shown that whilst the colour change from green to yellow which occurs in the fluorescence of iodine vapour by raising the vapour density is due to an increased absorption in the short wave-length region of the band spectrum, the superficially quite similar change which is observed by simply

raising the temperature is brought about by a decreased primary absorption and consequent reduced fluorescence in the corresponding spectrum region. The heating of iodine vapour at a constant density brings about, not only a displacement of the intensity in the whole absorption spectrum, but also effects an extensive change in the partition of energy of the individual bands.

J. F. S.

Ultra-red Absorption Spectra of Solid Substances in Thin Layers. O. REINKOBER (*Zeitsch. Physik.*, 1921, **5**, 192—197).—The ultra-red absorption spectra of the ammonium haloids have been measured. The method of preparing transparent layers for examination consisted in subliming the substances on to thin plates of transparent material, such as quartz, fluorspar, and rock salt. The spectra have been measured up to wave-lengths of about 8μ. The method is superior to the reflection method, particularly in the greater clearness of the spectra obtained. The following characteristic frequencies have been observed: ammonium fluoride 3·5, 4·5, 5·0, 6·0 ?, and $6{\cdot}69\mu$; ammonium chloride, 3·24, 3·5, 4·25, 4·95, 5·66, and $7{\cdot}07\mu$; ammonium bromide, 3·22, 4·3, 4·9, 5·9, and $7{\cdot}10\mu$; ammonium iodide, 3·22, 4·27, 5·0 ?, 6·0 ?, and $7{\cdot}15\mu$. These values are claimed to be more accurate than the corresponding values found by the reflection method, and they contain twelve values not found by that method. J. F. S.

Absorption Spectrum of Oxygen. J. DUCLAUX and P. JEANTET (*Compt. rend.*, 1921, **173**, 581—583).—Using a water prism, the authors have studied the ultra-violet absorption spectrum of oxygen, between $\lambda=1900$ and 2000. In addition to the seven bands observed by Bloch between $\lambda=1830$ and 1960, they find an eighth belonging to the same group which corresponds with the frequency formula $N=50727-2{\cdot}8m^2$, where $m=1$ to 9. A ninth band was observed but exact measurements were not made. A second group of bands similar to, but much weaker than, the first was observed in this region. The second group may be deduced from the first by a simple translation in the frequency scale, there being a difference of 1555 in the frequencies of corresponding rays in the two groups. W. G.

The Calculation of the Colour of "Cyclic" Coloured Substances. JAMES MOIR (T., 1921, **119**, 1654—1668).

The Numerical Values of the Optical Rotations in the Sugar Acids. P. A. LEVENE (*J. Biol. Chem.*, 1921, **48**, 197—202).—A theoretical paper in which calculations are made, by Hudson's method, of the optical rotations of the different asymmetric carbon atoms in the hexosamic acids. Using different combinations of four equations, it is shown that constant values for the β, γ, and δ carbon atoms are obtained only when the combination is so chosen that the value for the α-carbon atom is the same for each member of the combination. The author concludes that the superposition theory holds only within certain limits. E. S.

The Inversion of the Rotatory Power of Derivatives of Tartaric Acid. D. DE MALLEMANN (*Compt. rend.*, 1921, **173**, 474—477; cf. this vol., i, 158).—Sodium hydrogen *d*-tartrate shows a diminution in its rotatory power when dissolved in a saturated solution of sodium chloride and an inversion when dissolved in a strong solution of calcium chloride. Similarly, calcium *d*-tartrate shows a slight lævorotation when dissolved in calcium chloride solution. Ethyl *d*-tartrate has its rotatory power inverted in the presence of calcium chloride in either aqueous or alcoholic solution. Contrary to the effect of calcium chloride, the presence of copper chloride results in an increase in the rotatory powers of both *d*-tartaric and *d*-malic acids, both acids becoming more dextrorotatory. W. G.

Photochemical Decomposition of Silver Bromide. I. ROBERT SCHWARZ and HEINRICH STOCK (*Ber.*, 1921, **54**, [*B*], 2111—2122).—Owing to the non-availability of a suitable source of artificial light, the experiments deal with the behaviour of silver bromide towards daylight the intensity of which is measured by a self-recording actinometer. The silver bromide is prepared by the slow addition of potassium bromide solution (10%) in moderate excess to a dilute solution of silver nitrate acidified with nitric acid, the solutions being gently mixed; the preparations are effected in red light. The silver bromide is used in three forms (*a*) a caseous, flaky modification prepared as described, which passes when preserved into the plastic variety (*b*), and (*c*) the pulverulent modification obtained by shaking (*b*) with water. The silver bromide is allowed to settle on the bottom of small crystallising dishes in the form of a thin, uniform film and is washed repeatedly with water until free from bromide ions. It is covered with water and exposed to light in an apparatus which is so arranged that a current of air carries the liberated bromine into an aqueous solution of potassium iodide. According to the intensity of the illumination, the production of bromine is noticeable at the end of five to fifteen minutes. The experiments were generally continued for about four hours, at the end of which the bromide had assumed a pale grey to brown colour; variety (*a*) retains its caseous consistency, whereas the more compact form (*b*) suffers a further contraction and sometimes becomes detached from the edges, whilst form (*c*) remains unchanged except with regard to colour. The elimination of bromine occurs with the same regularities as are observed in the blackening of photographic emulsions. The sensitiveness of the various forms towards light diminishes in the order *b*—*a*—*c*. The time which is allowed for the transformation of form *a* into *b* is a matter of considerable importance, since the sensitiveness again diminishes when the form is more than one hundred and ten hours old. The most sensitive products are obtained after eighty to ninety hours. It is probable that a gradual change of form *b* into the less sensitive variety *c* occurs when agitation is avoided. Solarisation is a property of pure silver bromide, and is accompanied by diminished elimination of bromine. Speci-

mens of silver bromide obtained by the action of an excess of silver nitrate on potassium bromide do not evolve bromine when illuminated, but yield, in its place, a volatile substance which oxidises iodine. The phenomenon is explained on the hypothesis that the precipitate adsorbs silver nitrate and that fission of the silver bromide into silver and bromine actually occurs; the latter reacts with the adsorbed silver nitrate with the formation of hypobromous acid; the latter is removed by the air and oxidises the iodine in accordance with the equation: $I_2+5HBrO+H_2O=2HIO_3+5HBr$. The constancy in weight which has been observed in silver bromide when prepared in this manner and subjected to illumination is attributed to the re-formation of silver bromide from hypobromous acid and the liberated silver. Pre-illumination of silver bromide (by cautious exposure to light during precipitation) causes a greatly increased liberation of bromine on subsequent exposure. H. W.

The Developing Properties of Leuco-bases of Dyes derived from Rosaniline. A. LUMIÈRE, L. LUMIÈRE, and A. SEYEWETZ (*Bull. Soc. chim.*, 1921, [iv], **29**, 829—833).—The authors, working with pure substances, were unable to repeat Abribart's results (cf. *ibid.*, 1921, [iv], **29**, 265) on the use of the leuco-bases of malachite green and rosaniline as developers. They consider that his results were probably due to impurities in his leuco-bases. W. G.

The Corpuscular Spectra of the Elements. MAURICE DE BROGLIE and LOUIS DE BROGLIE (*Compt. rend.*, 1921, **173**, 527—529).—A discussion of the results obtained in the corpuscular excitation by *X*-rays of the heavy metals, uranium, lead, and thorium. The bearing on the *L*, *M*, and *N* layers of electrons is considered. W. G.

Fine Structure of Rontgen Spectra. II. *L* Series. ADOLF SMEKAL (*Zeitsch Physik.*, 1921, **5**, 91—105; cf. this vol., ii, 292).—It is shown that the whole of the Rontgen lines attributed to the *L* spectrum of tungsten can be brought into one general scheme, which demands the existence of at least five *M* layers. The existence of these is rendered fairly certain by a pair of well-defined lines in each case. This number shows the necessity of the determination of the quantum condition of each electron sheath by means of three quantum numbers. The explanation of K_β offered by Kossel (*ibid.*, 1920, i, 119) is confirmed and explanations are given for all hitherto uninterpreted *K* and *L* lines, which are in keeping with the relationships as found in the case of tungsten. The new relationships $K_\beta-K_{\beta'}=L_\phi-L_v$ and $K_\beta-K_a=L_\phi+L_1-L_3$ have been tested and found to be in complete accord with the known experimental data within the limits of experimental error. J. F. S.

Fine Structure of Röntgen Spectra. III. *M* Series and the Principle of Selection. ADOLF SMEKAL (*Zeitsch. Physik.*, 1921, **5**, 121—129; cf. this vol., ii, 292, and preceding abstract).—A paper supplementary to two previous papers (*loc. cit.*) in which

definite frequency relationships are given for the M lines γ and δ, and in the case of the other uninterpreted M lines the most probable of the possible explanations is pointed out. The relationship $M_\gamma = L_3 - L_1 - (L_\phi - L_\gamma)$ is the only relationship giving complete agreement with facts, which can be found from the investigation of a great range of order numbers. It is shown how apparent difficulties in the principle of selection, as in the case of Kossel's arrangement of K_β, may be avoided. On the other hand, on account of a lack of exact relative intensity data for the whole of the lines, it is not possible to draw general conclusions as to the form of the principle of selection which holds for energy levels which are unlike hydrogen. J. F. S.

Action of Infra-red Rays on Phosphorescence. MAURICE CURIE (*Compt. rend.*, 1921, **173**, 554—555; cf. this vol., ii, 233).—No diminution was noticed in the intensity of the radiation reflected from the face 110 of a cubic crystal of blende illuminated by X-rays after inundating the crystal with infra-red rays. W. G.

The Opening up of Earths Poor in Radium. ERICH EBLER and A. J. VAN RHYN (*Zeitsch. angew. Chem.*, 1921, **34**, 477—480; cf. Ebler and Bender, A., 1915, ii, 128).—A number of uranium minerals, including carnotite and the uranium micas autunite and chalcolite, which are found in a magma of sandstone or decomposed granite, have been examined with the object of discovering a simple method of extracting the radioactive elements from the bulk of the inactive material. In the case of Portuguese uranium micas, more than forty times as much radium was found in the micaceous material, separated mechanically from the ground-mass of siliceous material, as in the latter, but the proportion of radium to uranium in the mica, 1.7×10^{-7}, was less than in the ground-mass, 9.8×10^{-7}, the latter being greater than the theoretical value, 3.4×10^{-7}. This anomaly may be explained on the assumption that part of the radium has been dissolved out of the mica by infiltration, and then partly redeposited in the absorbent siliceous mass, consisting of decomposed granite and containing as much as 94.2% of SiO_2. Experiments with normal granite show that over 60% of the radium present is contained in the mica and hornblende, the rest in the felspar, whilst the quartz is free from radium.

More than 80% of the radium present in these minerals can be obtained in the form of crude sulphate by the following method. The powdered mineral is mixed with about an equal weight of sodium or calcium chloride and calcium carbonate, and heated at the sintering temperature (800—1000°) for five or six hours in a muffle furnace. The cooled mass is powdered and extracted with dilute hydrochloric acid containing sulphuric acid and barium chloride. The sulphate precipitate containing the radioactive material can then be readily washed away from the coarse inactive particles and filtered off. The weight of crude sulphates obtained is about 7% of the original ore. This method was used to extract radium from Portuguese torbernite ore containing only 4.5×10^{-7}%,

from Colorado carnotite sandstone containing $5 \cdot 0 \times 10^{-7}\%$ and from Mexican pitchblende-quartzite containing $2 \cdot 84 \times 10^{-7}\%$ of radium.

E. H. R.

The Disintegration Constant of Radium Emanation. W. BOTHE and G. LECHNER (*Zeitsch. Physik.*, 1921, **5**, 335—340).—The disintegration constant of radium emanation has been determined by comparing the emanation directly with the radium preparation from which the standard solution was made. Two values of λ were obtained which agreed to one per thousand, and gave a mean of $0 \cdot 1819$ day^{-1}=$2 \cdot 106 \times 10^{-6}$ sec.$^{-1}$. From this the half life is 3·810 days. These values are about 1% greater than the generally accepted Curie-Rutherford values. It is shown that in emanation measurements the often untrustworthy standard solution can be dispensed with if a radium standard and some radium emanation are available. The once determined sensitiveness of the emanation electrometer, found by means of a tube of emanation, may be made the basis of measurements for a long time, if the γ-ray sensitiveness is controlled for each measurement. A table is appended to the paper which gives the decay of radium emanation and the formation in radium preparations which are not in equilibrium.

J. F. S.

Range and Ionisation of the α-Particles from Radium-*C* and Thorium-*C*. G. H. HENDERSON (*Phil. Mag.*, 1921, [vi], **42**, 538—551).—The ionisation curves of Ra-*C*, Th-C_1 and Th-C_2 in air were measured, particular attention being directed to the end-portions. A considerable part of each curve is approximately a straight line. The gradual flattening of the curve at the end of the range can be accounted for by small variations in the ranges of individual α-particles, due to probability variation in the number of electrons encountered by the α-particle along its path. An "extrapolated range" is suggested as more suitable than the usual definition, and is obtained by prolonging the straight part of the curve. This extrapolated range in air at 0° is 6·592 cm. for Ra-*C*, 4·529 cm. for Th-C_1, and 8·167 cm. for Th-C_2. A general equation for the end part of the curve is suggested.

J. R. P.

The Accumulation of Radioactive Substance in Ferruginous Spring Deposits. F. HENRICH (*Ber.*, 1921, **54**, [*B*], 1715—1722). The preliminary treatment of the sediment is effected with hydrochloric acid, whereby a portion remains undissolved which contains silica (46·7%), calcium oxide (12·1%), iron oxide (11·5%), aluminium oxide (4·44%) organic matter (3%), and smaller amounts of arsenic, manganese, etc. The solution is treated with ammonia, giving a precipitate containing iron oxide (61%), calcium oxide (5·8%), manganese oxide (5·7%), aluminium oxide (3·67%), and small amounts of arsenic, strontium, etc., together with 2·54% of matter insoluble in hydrochloric acid. The latter is re-dissolved, but enrichment of the solution in radioactive matter is found impossible by fractional precipitation of the iron as ferric hydroxide. If, however, the iron is reduced to the ferrous state and slow

crystallisation of ferrous sulphate is induced, it is found that the initial deposits are completely inactive and the subsequent ones only slightly active, becoming, in general, completely inactive after a single crystallisation from water. A very considerable enrichment of the solution can thus be effected, and the active material can then be deposited on ferric hydroxide by oxidation and subsequent addition of ammonia to the solution. If desired, the last traces of iron can be removed electrolytically from the solution and the active substance then deposited on any desired carrier, but the procedure does not appear to offer any particular advantage.

The residue (see above) is treated with hydrofluoric and sulphuric acids for the removal of silica, whereby the organic matter becomes charred and the carbon disseminated through the inorganic matrix. The latter may be almost completely removed by treatment with boiling hydrochloric acid (1 : 2). The residue invariably exhibits relatively great activity, which is yet more pronounced in the ash left after ignition. Attempts to secure an active deposit by treatment of the solutions with animal charcoal were, however, unsuccessful. The filtrate from the treatment of the charred product is concentrated when gypsum and alum successively separate in an inactive condition; subsequent concentration of the active matter is then effected by the ferrous sulphate method. H. W.

Further Light on the Theory of the Conductivity of Solutions. GUY CLINTON (Pamphlet, pp. 15).—A theoretical discussion of the hypothesis of electrical conduction of solutions. It is pointed out that Kohlrausch's principle is stated first as a law of moving ions and secondly as a function of the resistance. The illustration put forward by Hittorf is examined, and shown to be incapable of showing the possibility of the equivalency of discharge when the ions move with unequal velocity. The same question is examined mathematically, and the conclusion is drawn that Kohlrausch's law of ionic movements is not in harmony with Faraday's law of discharge. It is suggested that the Kohlrausch statements need revision, to keep them within the limit of experimental evidence. The author proposes the following: During the early period of electrolysis, in parts of the cell remote from the points of discharge, with certain amendatory assumptions, the sum of the velocities of the kation and anion is proportional to the molecular conductivity of the solution. It is pointed out that velocities have been measured in but a small part of the cell, whilst resistance is measured for the whole cell, and that such values are not comparable. The author describes a cell in which the velocity for the whole distance between the electrodes is determined. This, only, is comparable with the fall in the potential for the entire cell. It is shown experimentally that the lead ion moves downward toward the cathode with a velocity of 0·113 cm. per sec., but upward to the cathode with a velocity 0·00457 cm. per sec, the potential gradient being unity in each case. Whetham's explanation for the exceptional congestion in solutions of cadmium iodide is quoted, and it is suggested that it might be applied to explain all cases of

congestion. The effect of hydration of ions on ionic velocities is examined. It is pointed out that previous work takes no account of the eddies formed in the system. J. F. S.

Ionic Mobilities, Ionic Conductivities, and the Effect of Viscosity on the Conductivity of certain Salts. DUNCAN A. MACINNES (*J. Amer. Chem. Soc.*, 1921, **43**, 1217—1226).—A theoretical paper in which it is shown that the changes in the transport numbers with concentration indicate that variations of ionic mobility with concentration must be considered in any theory of strong electrolytes. Since the changes in the transport numbers can indicate only differences of mobilities, it seems very probable that the actual changes are greater than these differences. Since there is at present no method of distinguishing between variations of the equivalent conductivity due to (*a*) changes of the number of ions, (*b*) changes of the mobilities of the ions, it seems desirable to consider a group of these substances as completely dissociated, and all variations of conductivity as due to changes of mobility. The latter changes can conceivably arise from the increasing strength with concentration of the electrical field due to the ions. The evidence in favour of this view is most clear in the case of the alkali haloids and hydrochloric and nitric acids. These substances fulfil a further condition of complete dissociation, namely, additivity at each concentration, of the conductivity except in so far as this property is modified by the changing viscosity. Any degree of dissociation less than that represented by the limiting case can be found in solutions of electrolytes, particularly of weak electrolytes and those possessing multivalent ions. But this dissociation cannot be calculated from the ratio Λ/Λ_0, since the changes of the transport numbers with concentration indicate that changes of ionic mobility also occur in these solutions. In the case of strong electrolytes, there does not appear to be any property which can be computed from the conductivity ratio. The activity coefficients of the ions of the alkali chlorides and hydrochloric acid are first lower and then much higher than the corresponding ratios as the concentrations are increased, whilst the free energy contents of these ions have been found to be additive at each concentration, as would be expected if they were completely or almost completely dissociated. J. F. S.

Electrode Reactions. Contractometric Observations at Anodes. V. KOHLSCHÜTTER and H. STÄGER (*Helv. Chim. Acta*, 1921, **4**, 821—837).—An extension of the contractometric method (A., 1920, ii, 728) to the study of anode changes in electrolytically unchangeable electrolytes, yielding hydrogen at a platinum black electrode. The anodes consisted of electrolytic deposits of the metal to be investigated on platinum contractometer plates, a sheet of the metal itself being alternatively employed in the case of copper (cf. A., 1920, ii, 624). The results of a study of platinum anodes in sulphuric acid or sodium hydroxide solution, of nickel, copper, and iron anodes in sodium hydroxide solutions, of passive iron in nitric acid, and of copper and silver in sodium sulphide

solutions show that the method is not inferior in applicability to the dilatometric method. The details do not lend themselves to concise reproduction. J. K.

Electrode Processes in the Presence of Colloids. N. ISGARISCHEV (*Koll. Chem. Beihefte*, 1921, **14**, 25—62).—The cathodic and anodic polarisation in the electrolysis of solutions of zinc sulphate and copper sulphate has been investigated in the presence of gelatin, gum, and sucrose. The potential of zinc and copper has been determined in the same solutions and also the viscosity and the electrical conductivity of the solutions. It is shown that a maximum polarisation is set up and also a maximum potential at a definite concentration of the added substance. In a molecular solution of zinc sulphate the maximum occurs with 0·025% of gelatin, 2% of gum arabic, and 30% of sucrose, and with copper sulphate solution the maximum occurs with 0·30% of gelatin. This maximum is explained by the hypothesis that the kations form adsorption compounds with the colloid and these exert an action on the velocity of the cathode processes, but none on the anode processes. In the case of sucrose, the polarisation is explained as due to a chemical combination between the sugar and the zinc sulphate. The heat of formation of the adsorption compound between the zinc ion and gelatin is found by the electrometric method to be $\Delta Q = -2150$ Cal. The ultramicroscopic investigation of the above-named solutions shows a characteristic change in the form of the particles with increasing colloid concentration. A connexion between the polarisation phenomena and the structure of the electrolytically deposited metals is established. The change in the crystallisation phenomena, the crystalline form of the metal, and the polarisation are brought about by the relatively slow formation of the ions from the complexes. Similar results have also been obtained with solutions of nickel sulphate. In this case the maximum polarisation is found with solutions containing 0·95% of gelatin. J. F. S.

Electrolytic Oxidation and Reduction in Presence of Metallic Salts. MAX SCHLÖTTER (*Zeitsch. Elektrochem.*, 1921, **27**, 394—402).—In the electrolysis of chloride solutions for the manufacture of chlorate, the addition of a small quantity of a metallic salt, for instance a manganese salt or a chromate, has a favourable effect on the current efficiency of the process, apparently by preventing reduction from taking place in the cell. Experiments to investigate the part played by the metallic salt were made, using as electrolyte a saturated solution of potassium chloride with platinum electrodes. The amounts of reduction and of decomposition of water taking place were determined by analysis of the electrode gases for hydrogen and oxygen. It was found that the effect of the addition of a metallic salt to the electrolyte was determined, not only by the character of the metal, but equally by its concentration. Certain metals, such as copper (0·5 gram of cupric chloride per litre) and lead (0·21 gram lead dioxide per litre), eliminated reduction almost entirely. Tin, when 0·5

gram of stannous chloride per litre was added, had little effect, but when only one-tenth of this quantity was used, reduction was brought down to a very low figure. It was always observed that, after addition of the metal salt, several hours had to elapse before the cell settled down to a steady state. This is probably due to the time required for the deposition of the metal on the electrode. Since the most favourable results are obtained with a very small quantity of added metal, it appears that the cathode does not then become completely covered with the deposited metal, but that the latter forms a network over the electrode metal. The form of electrode which then gives the best results is probably one which consists of the system electrode metal–deposited metal–hydrogen. This conclusion was supported by experiments in which metals other than platinum were used for the cathode. When a copper cathode is used, addition of copper to the electrolyte has no effect on the reduction. With an iron electrode addition of copper increases the amount of reduction in the cell, whilst with a copper electrode addition of iron lowers the percentage reduction, although the reduction value of a pure iron electrode is much higher than that of a pure copper electrode. This is explained by the fact that electrolytically deposited iron absorbs more than one hundred times its volume of hydrogen, forming a stable system in which the activity of the hydrogen is reduced to a low value. The potential energy of the hydrogen at the cathode depends on the nature of the deposited metal, and it should be possible, by choosing a suitable system, to obtain conditions for the quantitative reduction of any substance. E. H. R.

Velocity of Sound in Gases at High Temperatures and the Ratio of the Specific Heats. HAROLD B. DIXON, COLIN CAMPBELL, and A. PARKER (*Proc. Roy. Soc.*, 1921, [*A*], **103**, 1—26).—Direct measurements were made of the time taken by a sound wave to travel through the gas contained in a tube of known length, by means of a pendulum chronograph. The sound was propagated through tubes of lead, mild steel, and silica. The lead tubes were used up to 100°; at higher temperatures, the steel and silica tubes were used, being heated in a gas furnace, and electrically, respectively. The values of c_p/c_v, and the true specific heats calculated by Berthelot's equation, are given: for air (0—700°), nitrogen (0—1000°), carbon dioxide (0—600°), methane (0—600°), and ethane (0—100°), and the values of c_v are represented by the following equations (t=temperature; T=absolute temperature): nitrogen $4{\cdot}775+0{\cdot}00042T$; air $4{\cdot}8+0{\cdot}0004T$; carbon dioxide $6{\cdot}30+0{\cdot}00205T+0{\cdot}0000007T^2$; methane $6{\cdot}66+0{\cdot}019t$; ethane $9{\cdot}04+0{\cdot}0183t$. J. R. P.

Ratio of the Specific Heats of Air and Carbon Dioxide. J. R. PARTINGTON (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 27—49).—The values of c_p/c_v for air and carbon dioxide at 17° were found by the method of adiabatic expansion and the specific heats calculated by Berthelot's equation. For air, $c_p/c_v=1{\cdot}4034$; for carbon dioxide, $c_p/c_v=1{\cdot}3022$. J. R. P.

Freezing Points of Organic Substances. VI. New Experimental Determinations. J. TIMMERMANS and TH. J. F. MATTAAR (*Bull. Soc. chim. Belg.*, 1921, **30**, 213—219; cf. A., 1911, ii, 854; 1914, ii, 168; this vol., ii, 430—431).—The freezing points of seventy-three compounds of the fatty series, liquid at the ordinary temperature, including alkyl haloids, ethers, ketones, acid anhydrides and chlorides, esters, and amines, are given in tabulated form with notes and references to earlier determinations where such have been made. The freezing points given range from $-13°$ to $-140°$.

J. H. L.

Some Relations between Absolute Critical Temperatures of Ebullition and Fusion. J. J. VAN LAAR (*J. Chim. physique*, 1921, **19**, 4—8).—The regularities described by Prud'homme (A., 1920, ii, 587) are purely arithmetical and have no physical meaning. Relations are deduced from the formula of van der Waals: $\log p/p_c=f(T_c/T-1)$, where f may depend slightly on temperature. If T_1=boiling point, $p=1$ atm., then $\phi_1=T_c/T_1=\log p_c/f_1+1$. ϕ_1 will therefore be approximately constant unless p_c is abnormal (helium). In the case of fusion, $(v_2-b_2)/v_2=1/14$, where v_2-b_2 is the effective volume for molecular motion. Thence $\phi_2=T_c/T_2=2a_c/\gamma a_2$, where T_2=m. p., a is the attraction constant, and γ is usually 0·9, but for ideal substances (a and b constant) is 0·5. For ordinary substances, $a_2=1{\cdot}4a_c$; $\phi_2=2$. For limiting substances (with T_c from 400 to 500°), $\phi_2=1{\cdot}83$, which agrees with the rule of Timmermans (this vol., ii, 430) that the melting points of different families of substances tend to an upper limit of 117° C.

J. R. P.

A Differential Thermometer. ALAN W. C. MENZIES (*Proc. Nat. Acad. Sci.*, 1921, **7**, 81—83).—A water-filled differential thermometer for use in ebullioscopic measurements is described. The thermometer consists of a length (12 cm.) of stout-walled pyrex glass blown to a bulb at its upper end and bent and enlarged at its lower end. Before sealing, all air is expelled by boiling, so that the pressure generated at either end is due to the vapour of the indicating liquid. Both the stem and the lower bulb are graduated in mm. The various errors associated with the Beckmann thermometer are discussed in connection with the present instrument.

J. F. S.

Applications of a Differential Thermometer in Ebullioscopy. ALAN W. C. MENZIES and SIDNEY L. WRIGHT (*Proc. Nat. Acad. Sci.*, 1921, **7**, 77—80).—The authors described a modification of the Cotterell ebullisocopic apparatus (A., 1919, ii, 447; 1921, ii, 240) which involves the use of a loose pump which is hung on the lower bulb of a differential thermometer (cf. preceding abstract), a sealed-on condenser attached to the top of the boiling tube, and down the centre of which is a glass rod attached to the thermometer to hold it in position. The bottom of the boiling tube is constricted to form a bulb, which contains the whole of the solvent. and a graduated neck. In this way, the volume of liquid may be read immediately

the ebullition has ceased and before the condensed liquid has had time to drain back into the bulb. The apparatus has no corks in its construction. The authors claim that with this apparatus readings may be obtained as rapidly as fresh portions of the dissolved substance can be weighed, and these have an error not larger than 0·5%. J. F. S.

An Improvement in Barger's Method for the Estimation of Molecular Weight. KARL RAST (*Ber.*, 1921, **54**, [*B*], 1979—1987).—The main innovation consists in the replacement of the individual drops used in the original method (T., 1904, **85**, 286) by a single larger drop which is placed in a capillary tube and is fixed at one end. The variations in the size of the drop are therefore much greater and a single reading only is involved. A further advantage lies in the possibility of using volatile solvents such as ether or pentane, whilst, in addition, less trouble is involved when less volatile solvents are used at increased temperatures.

A capillary tube, 0·5—1·2 mm. in external diameter and 20—30 cm. long, is filled successively to a length of about 5 cm. with the comparison solution, a bubble of air 3—4 mm. long, and then with the solution under investigation to a length of 4—5 cm. The latter is drawn into the tube so as to leave about 3 cm. free. The "comparison" end of the tube is sealed and the other end drawn out to an exceedingly fine capillary, which is broken off so that a length of about 2 cm. remains, and is then sealed. The "comparison" end is broken and the solution allowed to flow down to the fine point, after which it also is drawn out and sealed. The tube is now mounted in a Petri dish, and the observations are made under the microscope as in the original method. It is convenient to have the two solutions of different colours; a suitable standard is provided by azobenzene for all solutions which are not red, and by naphthalene for red solutions. Solvents of low boiling point, for example, ethyl ether, ethyl acetate, acetone, carbon disulphide, alcohol (90%), or a mixture of pyridine and acetone, are particularly serviceable, since the changes then occur with convenient rapidity. If desired, a series of solutions, separated from each other by bubbles of air, may be used in the same capillary. H. W.

A Flame with Very High Temperature. ERNST HAUSER and ERNST RIE (*Sitzungsber. K. Akad. Wiss. Wien*, 1920 [IIA], **129**, 539—547; from *Chem. Zentr.*, 1921, iii, 588).—An inflammable liquid is fed to a specially constructed burner, where it is atomised by means of a chemically indifferent gas (hydrogen) to a horizontal cone. This is invested with a mantle of oxygen blown from the peripheral portion of the burner. A temperature of more than 3000° is thus obtained. Using this flame, carbon was changed into graphite or, under certain conditions, into minute, transparent, highly refracting crystals. G. W. R.

Radiation Theory of Thermal Reactions. W. C. M. LEWIS and A. MCKEOWN (*J. Amer. Chem. Soc.*, 1921, **43**, 1288—1306).—A theoretical paper in which an expression is obtained for the

velocity of a unimolecular reaction in a gaseous system, on the basis of the radiation hypothesis of thermal reactions, making use of continuous absorption of radiation by an oscillator. The expression obtained is $k_{uni}=(8\pi^2e^2n_m{}^3\nu^2/3mc^3)\cdot\epsilon^{-h\nu/kT}$, in which k_{uni} is the unimolecular velocity constant, e and m are the charge and mass of the electron, ν is the frequency of the radiation characteristic of the reaction, k and h are the constants of Boltzmann and Planck, respectively, T is the absolute temperature, and n_m the refractive index of the substance in an ideal state corresponding with the closest possible packing of the molecules. The term n_m is shown to have a value of approximately 200, which is practically independent of the system considered and of the temperature. The expression for the velocity constant agrees with the experimental data of unimolecular reactions, so far as they are known. By considering reversible reactions of the dissociation type, an expression is obtained for the equilibrium constant which is shown to be in good agreement with the experimental data for iodine given by Bodenstein and Starck (A., 1911, ii, 20). Recent criticisms of the radiation hypothesis have been considered and answered. In view of the nature of the criticisms, it is essential to emphasise the distinction rather than the resemblance between thermal and photochemical processes. The resemblance lies in the fact that both processes are attributed to radiation, whilst the distinction enters in the manner and extent to which the transformation of radiant energy occurs. Thus Langmuir attributes the mechanism of a thermal process to rate of emission from a surface, which mechanism, however, characterises photochemical action only. On the other hand, Lindemann considers photochemical action, but regards it from the point of view of radiation density, which is shown to define thermal velocity and not photochemical velocity, when the radiation has the same temperature as the matter. J. F. S.

Volume of Kations in Permutite. A. GÜNTHER-SCHULZE (*Zeitsch. Physik.*, 1921. **5**, 324—330; cf. this vol., ii, 9).—The molecular volume has been determined at 18° for a number of permutites containing different kations, and from the space taken up by the kation the kation volume has been calculated for lithium, sodium, potassium, ammonium, rubidium, silver, magnesium, calcium, strontium, barium, cadmium, thallium, lead, and uranyl ions. These values are compared with the atom radius and the kation radius. In most cases, the determined kation volume is smaller than the atomic volume; only in the case of the four elements with large atomic weights, silver, cadmium, lead, and thallium, is the reverse the case. In the case of lithium, potassium, and rubidium, the atomic radii agree very nearly with those deduced by Lorenz from diffusion experiments in mercury. J. F. S.

Surface Tensions of Salts of the Fatty Acids and their Mixtures. ERIC EVERARD WALKER (T., 1921, **119**, 1521—1537).

Adsorption of Gas by Charcoal, Silica, and other Substances. HENRY BRIGGS (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 88—102).—The adsorptive capacities of charcoal and silica at liquid

air temperatures ($-150°$) were compared, especially as relates to hydrogen and nitrogen. Evaluations were made of the volume of solid matter, the interstitial space between the granules, and the internal gaseous space. The pressure of capillaries is not sufficient to account for adsorption. It is argued that a vitreous solid is a complete atomic linking; activation is considered to be the effect of disrupting the solid polymerides, and the means of accomplishing the partial depolymerisation of charcoal and silica is described.

J. R. P.

Stoicheiometry of Adsorption. II. Adsorption of Potassium and Barium Salts of Various Anions. SVEN ODÉN and E. W. LANGELIUS (*J. Physical Chem.*, 1921, **25**, 385—398; cf. this vol., ii, 438).—The adsorption of the hydroxide, bromide, thiocyanate, nitrate, and chloride of potassium and barium, and the iodide, sulphite, fluoride, ferrocyanide, citrate, chromate, sulphate, and chlorate of potassium by charcoal has been determined by the interferometric method previously described (*loc. cit.*). In the case of the potassium salts, the concentration–adsorption curves cross one another, that is, the order of adsorption varies with concentration. With a concentration 0·010*M*, the order is: fluoride < chloride < sulphate < nitrate < chloride < bromide < ferrocyanide < citrate < chlorate < chromate < iodide, whilst at 0·2*M* the order is: sulphate < fluoride < ferrocyanide < chloride < bromide < chromate < citrate < nitrate < chlorate < iodide < cyanide. In the case of the barium salts, the order of adsorption does not change with change in concentration, except perhaps in the case of the acetate, and the order is the same as that for the potassium salts at the concentration 0·05*M*; the order is: chloride < bromide < acetate < nitrate < thiocyanate < hydroxide.

J. F. S.

Adsorption by Precipitates. IV. HARRY B. WEISER (*J. Physical Chem.*, 1921, **25**, 399—414; cf. A., 1920, ii, 228; 1919, ii, 269).—A number of experiments on the adsorption of oxalate, chromate, and dichromate ions by hydrated ferric oxide are described, and experiments are also described on the quantities of electrolytes required to coagulate a colloid. It is shown that the amount of electrolyte required to coagulate a colloid is influenced by the rate of addition. Since a quantity of electrolyte that will cause complete coagulation when the addition is rapid will not cause complete coagulation when the addition is slow, the colloid is said to have become acclimatised, and the phenomenon is termed acclimatisation. This term is a misnomer, since the colloid does not become acclimtised to the presence of the electrolyte in the ordinary sense of the word. The amount of precipitating ion carried down by a colloid is determined by the adsorption of the electrically charged particles during neutralisation and the adsorption of the electrically neutral particles during agglomeration. The adsorption of oxalate, chromate, and dichromate by hydrated colloidal ferric oxide emphasises the importance of adsorption by neutralised particles in

determining the amount of electrolyte carried down by a precipitated colloid. The drop-by-drop addition of an electrolyte to a colloid over a long period is accompanied by fractional precipitation of the colloid and the precipitating ion. The precipitation value is such a concentration of precipitating ion added all at once that sufficient adsorption to cause neutralisation of the colloidal particles can take place promptly. The necessity for using more electrolyte to effect complete precipitation on slow addition arises, not from the adaptability of the colloid to the presence of the electrolyte, but from the fact that the fractional precipitation during slow addition continually removes ions owing to adsorption by the neutralised particles during agglomeration; and this loss must be compensated. The excess of electrolyte required for a given slow rate of addition is determined by (*a*) the extent to which the colloid undergoes fractional precipitation, (*b*) the adsorbing power of the precipitated colloid, and (*c*) the adsorbability of the precipitating ion. The amounts adsorbed at the precipitating concentration of the various ions are not equivalent, as Freundlich assumes. Adsorption of equivalent amounts effects neutralisation of the charged particles, but adsorption during agglomeration varies with the concentration and adsorbability of the ion. Comparable adsorption values cannot be obtained at the precipitation concentration on account of the variability of the latter. J. F. S.

Method of Photographing Transparent Crystals. M. François and Ch. Lormand (*Bull. Soc. chim.*, 1921, [iv], **29**, 792—807).—Full details are given for the photomicrography of transparent crystals. A simple apparatus is described and illustrated, including a method of illuminating the crystals. Instructions are given as to choice of plates, method of development, and a method for calculating the time of exposure. W. G.

Determination of Crystal Structures by Means of *X*-Rays. M. von Laue (*Naturwiss.*, 1920, **8**, 968—971; from *Chem. Zentr.*, 1921, iii, 505—506).—A theoretical discussion showing the limitations of the *X*-ray method for the determination of crystal structures. It is pointed out that the lattice image is not a refraction, but an interference, image. Information as to crystal structure is actually obtained by considering the results obtained with rays falling at different angles and of different wave-lengths. Additional information is given by chemical constitution, the dispersive power of the atoms present for the rays used, crystal form, and the mathematical theory of simple and compound space lattices. G. W. R.

The Chemical Reactions of Crystals and their Relation to the Molecular Structure. F. Rinne (*Z. Metallk.*, 1921, **13**, 401—406).—A theoretical paper dealing with the arrangement of the atoms and molecules in crystals and their relation to the symmetry of the crystal. It is shown that the action of reagents on crystals takes place in a symmetrical manner and if carried out slowly results in the development of symmetrical figures on the surface of the crystals which vary according to the relation of the

face attacked to the axes of the crystal. An explanation of this and of the change of crystal form that some minerals undergo on heating is given, based on the space-lattice theory of crystal structure.

A. R. P.

Methods for [Effecting] the Orientation of Crystal Elements. R. BECKER, R. O. HERZOG, W. JANCKE, and M. POLÁNYI (*Zeitsch. Physik*, 1921, **5**, 61—62).—Several methods are described whereby an axial orientation of crystal elements in various types of substances may be produced. 1. A crystalline powder placed in a magnetic field so arranges itself that individual crystalline particles take up positions corresponding with the inductive action. 2. Subjecting crystalline powders and substances like wax and paraffin to high pressures (4000—5000 atms.) brings about a marked regular arrangement of the particles. This is observed in the case of the substances succinic acid, indigotin, and stearic acid. 3. The cold drawing of metals produces an axial symmetry of the elementary crystals of the metals.

J. F. S.

Constitution of Mixed Crystals and the Space Filling of the Atoms. L. VEGARD (*Zeitsch. Physik*, 1921, **5**, 17—26).—A continuation of previous work (A., 1917, ii, 243). In the present paper the structure of mixed crystals of potassium bromide and chloride, potassium and ammonium chloride, and potassium and ammonium sulphate has been examined by means of *X*-ray spectra, using the Debye-Scherrer powder method. The reflection maxima have been photographed for the mixed crystals named above and their components. The results indicate the replacement of one atom by another in mixed crystals is irregular and unordered, so that mixed crystals are to be defined as those substances which are characterised by an unordered atomic substitution. The change of the position of the reflection maxima denotes a change in the molecular volume. The replacement of bromine by chlorine effects a contraction, whilst the replacement of potassium by ammonium effects an expansion of the crystal lattice. The length of the side of the elementary lattice of the mixed crystals of potassium bromide and chloride is given with great accuracy by the formula $a_m = (p-100)/100 \cdot a_{KBr} + p/100 \cdot a_{KCl}$, in which p is the molecular per cent. of the potassium chloride in the mixed crystal and a_m, a_{KCl}, a_{KBr} are respectively the lengths of the sides of the lattices of the mixed crystal, potassium chloride, and potassium bromide. The crystal lattice of ammonium chloride is shown to be a cubic chlorine lattice centred round a similar nitrogen lattice. It is shown that the ammonium radicle takes up more space in the ammonium chloride lattice than in that of the face-centred type. The diameter of the hydrogen atom is calculated from the data obtained for ammonium chloride and bromide and values between 1·58 Å.U. and 1·68 A.U. obtained.

J. F. S.

The Colloid Mill and its Applications. HERMANN PLAUSON (*Zeitsch. angew. Chem.*, 1921, **34**, 469—472; 473—474).—Two types of machine are described, designed for the preparation of

colloidal solutions by mechanical means. The first type, suitable for dispersing typical colloids in a suitable dispersion medium, depends on the hammer-and-anvil principle, whilst the second, which depends on friction, is suitable for the preparation of colloidal solutions of such substances as minerals, dyes, or carbon. It is shown that definite saturated colloidal solutions can be prepared by means of such machines, but that the saturation limit can be raised by the addition of dispersion accelerators or "dispersators," which may be compared in their action with chemical catalysts. Numerous technical applications of the colloid mill are discussed, especially a new application in the viscose artificial silk process. With a suitable dispersion medium, cellulose can be reduced in the colloid mill to the colloidal form, and in this state it reacts with the theoretical quantity of alkali to form alkali cellulose which in turn reacts smoothly with carbon disulphide to give xanthogenate without the formation of any thio-salts as by-products. [Cf. *J. Soc. Chem. Ind.*, 1921, Nov.] E. H. R.

The Hydration of the Fibres of Soap Curd. III. Sorption of Sodium Palmitate. MARY EVELYN LAING (T., 1921, **119**, 1669—1676).

Statistical Mechanics and Chemistry. E. P. ADAMS (*J. Amer. Chem. Soc.*, 1921, **43**, 1251—1254).—A theoretical paper in which the view is advanced that if the laws of chemical dynamics are found to be consistent with the principles of statistical mechanics it is not only unnecessary, but even unjustifiable, to introduce the quantum hypothesis to derive these laws. The author shows that Tolman's criticism (this vol., ii, 99) of Marcelin's attempt (A., 1915, ii, 328) to base a theory of chemical dynamics on the principles of statistical mechanics, is unfounded. The main point of Tolman's criticism is that Marcelin has confused Gibbs's canonical distribution of an ensemble of systems with the Maxwell-Boltzmann distribution. The author shows that the form of the Maxwell-Boltzmann law used by Marcelin may be derived without making any use of the canonical distribution of Gibbs. J. F. S.

A Piezoelectric Method of Measuring Explosion Pressures. DAVID A. KEYS (*Phil. Mag.*, 1921, [vi], **42**, 473—488).—The piezoelectric properties of tourmaline crystals were used in conjunction with a special form of cathode ray oscillograph to record the pressures developed in explosions and the velocity of explosion waves in water. [See *J. Soc. Chem. Ind.*, 1921, 760A.] J. R. P.

Gaseous Combustion at High Pressures. II. The Explosion of Hydrogen–Air and Carbon Monoxide–Air Mixtures. WILLIAM ARTHUR BONE and WILLIAM ARTHUR HAWARD (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 67—84; cf. A., 1915, ii, 684).—The rise of pressure in the explosion of mixtures of hydrogen and air occurs very rapidly, but there is evidence of development of heat for a short period after the attainment of the maximum pressure. The rise of pressure in the explosion of carbon monoxide and air occurs

much more slowly, and cooling is delayed for a long period after the maximum pressure has been reached. The presence of even 1% of hydrogen in the carbon monoxide–air mixture, at the high initial pressures employed, accelerates the rise of pressure on explosion to a high degree. A theory is proposed to account for the different modes of explosion of hydrogen and carbon monoxide.

J. R. P.

The Propagation of Flame in Mixtures of Ethylene and Air. WILLIAM RONALD CHAPMAN (T., 1921, **119**, 1677—1683).

A Periodic Reaction in Homogeneous Solution and its Relation to Catalysis. WILLIAM C. BRAY (*J. Amer. Chem. Soc.*, 1921, **43**, 1262—1267).—The action of hydrogen peroxide both as an oxidising agent and as a reducing agent has been studied in the case of its reaction with iodine. The reactions which occur are (1) $5H_2O_2+I_2=2HIO_3+4H_2O$ and (2) $5H_2O_2+2HIO_3=5O_2+I_2+6H_2O$. It is shown that far more peroxide disappears from the reacting system than can be accounted for by the above equations, consequently the reaction (3) $H_2O_2 \longrightarrow H_2O+\frac{1}{2}O_2$ must also take place and this is catalysed by the iodic acid–iodine couple. Using a mixture containing $0{\cdot}190M$ hydrogen peroxide and $0{\cdot}094M$ potassium iodate, the reaction was carried out at 60° in the presence of varying concentrations of sulphuric acid by measuring the rate of evolution of oxygen. In the case of $0{\cdot}055N$-sulphuric acid, it is found that after an induction period lasting a very short time the reaction takes place rapidly and smoothly; its rate is proportional to the concentration of both hydrogen peroxide and iodate, and is but little affected by the concentration of hydrogen ion above $0{\cdot}2N$. With a concentration of $0{\cdot}110N$-sulphuric acid, after the induction period (seven minutes) the reaction proceeds smoothly, and a faint permanent iodine coloration is observed, but the velocity of evolution of oxygen is much greater than in the case of an acid concentration $0{\cdot}055N$. With acid concentrations intermediate to the foregoing, the velocity of evolution of oxygen is not uniform, but periodic in nature. Taking acid concentrations $0{\cdot}073N$ and $0{\cdot}0916N$ respectively, it is found that the induction period is eighteen and twelve minutes respectively, and then the evolution of oxygen is periodic. The curves representing this show a series of relatively flat portions followed respectively by very steep portions. In the flat regions the colour due to iodine slowly deepens and in the steep regions slowly fades away. With the more dilute acid, the period is between three and three and a half minutes, but with the more concentrated acid the period slowly increases from ten to thirteen minutes. Thus with $0{\cdot}055N$-acid there is no periodicity, with $0{\cdot}070N$-acid there are periods of ten to thirteen minutes, with $0{\cdot}0916N$-acid periods of three to three and a half minutes, and with $0{\cdot}110N$-acid there is pure catalysis and no detectable periodicity. In the last case, however, it is likely that after a very short induction period the reaction consists of a large number of very short periods. This periodicity is taken

as furnishing direct evidence in favour of the intermediate compound hypothesis of catalysis. An experiment carried out at 25° shows that the periods may be made to extend over several days, and when no shaking takes place the oxygen does not leave the solution in bubbles, thus making the reaction strictly homogeneous.
J. F. S.

The Effect of Temperature on Platinum Black and other Finely-divided Metals. ROBERT WRIGHT and ROBERT CHRISTIE SMITH (T., 1921, **119**, 1683—1688).

Adsorption of Gases by Metallic Catalysts. HUGH STOTT TAYLOR and ROBERT MARTIN BURNS (*J. Amer. Chem. Soc.*, 1921, **43**, 1273—1287).—Measurements of the adsorption of hydrogen, carbon monoxide, carbon dioxide, and ethylene by finely-divided nickel, cobalt, iron, copper, palladium, and platinum have been made at various temperatures with the object of finding the relationship this phenomenon bears to catalytic activity, and particularly to the mechanism involved in hydrogenation reactions. It is shown that adsorption by these metals is a specific property quite different in nature from adsorption by inert adsorbents such as charcoal. The extent of the adsorption is shown to be a function of the mode of preparation, and is especially less pronounced the higher the temperature of preparation of the finely-divided metal. The relationship between this fact and the corresponding facts of catalytic behaviour has been pointed out. The adsorption isotherms have been studied in the cases, nickel and hydrogen and copper and carbon monoxide. In both cases, adsorption increases rapidly with increasing partial pressure below 300 mm., and becomes practically independent of pressure above this point. The significance of irreversible adsorptions of gases has been studied, and reasons are suggested for divergences between different catalysts. It is indicated that, in addition to the adsorption factor, it is necessary to consider some other factor in explaining catalytic activity, and it is shown that a combination of the temperature factor with the adsorption factor in catalytic action suggests a possibility of explaining the divergence between the catalytic activities of various metals.
J. F. S.

Catalytic Hydrogenation of Organic Compounds with Common Metals at the Temperature of the Laboratory. The Activity of Nickel Catalysts prepared at Different Temperatures. Influence of Oxygen on the Nickel Catalyst. IV. C. KELBER (*Ber.*, 1921, **54**, [*B*], 1701—1705; cf. A., 1917, ii, 215).—Willstätter and Waldschmidt-Leitz (this vol., ii, 187) have reduced nickel oxide, prepared by ignition of nickel oxalate, to metallic nickel at 350—360°, and describe the product as incapable of accelerating hydrogenation catalytically unless previously primed with air. The author has been unable to confirm their observations. He has further examined the behaviour of metallic nickel obtained by the reduction of basic nickel carbonate at different temperatures, the operation being effected in

the same vessel as is used for the subsequent hydrogenation experiments, thus avoiding any possible complication caused by exposing the product to air. The activity of the catalyst is examined in the case of aqueous solutions of sodium cinnamate. It is found that metallic nickel prepared at 350—360° is but little inferior in activity to that obtained at 300°, and notably superior to that produced at 210°. The material first described becomes completely inactive when shaken with oxygen at 18—20°, but, if treated with hydrogen at 70—80°, it becomes again active at the temperature of the laboratory. The latter phenomenon was not observed by Willstätter and Waldschmidt-Leitz, since they worked at 60°, a temperature at which the catalyst commences to regain activity.

H. W.

The Influencing of the Activity of Catalysts. IV. Oxidative Catalytic Dehydrogenation of Alcohols. II. KARL W. ROSENMUND and FRITZ ZETZSCHE (*Ber.*, 1921, **54**, [*B*], 2033—2037; cf. this vol., ii, 393).—Catalytic dehydrogenation by means of copper, quinoline, and nitro-compounds and oxygen leads to the production of aldehydes from primary aliphatic, aromatic, and heterocyclic alcohols and of ketones from secondary alcohols whereas tertiary alcohols remain unchanged. The method is useful in the cases of difficultly volatile or non-volatile alcohols, but has no advantage over the older processes when the more volatile alcohols are used.

Benzhydrol is almost quantitatively transformed into benzophenone when heated with quinoline and nitrobenzene in a current of oxygen; under similar conditions, triphenylcarbinol is unaffected. The yields of acetaldehyde, propaldehyde, and *iso*butaldehyde are 52%, 57%, and 75% respectively, but the volatility of the corresponding alcohol at the temperature necessary for the reaction renders the completion of the change difficult to secure. Fermentation amyl alcohol gives an 80% yield of the corresponding aldehyde. *o*-Chlorobenzyl alcohol (p-*nitrobenzoate*, yellow, monoclinic prisms, m. p. 93—94°), is converted into *o*-chlorobenzaldehyde (yield 86·2%), whereas furfuryl alcohol gives a 74% yield of furfuraldehyde.

Considering the number of factors involved in the reactions, it is not surprising to find considerable fluctuations in the optimal temperature for each change. The lower limit may be considered to lie at 125—130°, at which amyl alcohol is dehydrogenated; benzylhydrol and furfuryl alcohol give satisfactory results at 145°, benzyl alcohol at 165°, and *o*-chlorobenzyl alcohol at 195°; the upper limit of temperature is 180° and 165° in the cases of benzyl alcohol and furfuryl alcohol respectively. H. W.

The Influencing of the Activity of Catalysts. V. Catalytic Reduction of Esters and Aldehydes. KARL W. ROSENMUND, FRITZ ZETZSCHE, and F. HEISE (*Ber.*, 1921, **54**, [*B*], 2038—2042).—It has been shown previously (this vol., ii, 362) that the reduction of benzoyl chloride to benzyl alcohol is complicated by the reductive fission of benzyl benzoate (formed from unchanged benzoyl chloride

and benzyl alcohol) to benzoic acid and toluene, and by the formation of dibenzyl ether. The first-named reaction is shown in the cases of benzyl benzoate and benzhydryl benzoate to take place readily in the presence of xylene and more slowly in the presence of toluene; it is almost completely inhibited by the addition of quinoline. Benzaldehyde is converted by hydrogen in the presence of palladium and xylene mainly into dibenzyl ether, the production of which is hampered whilst that of benzyl alcohol is facilitated by increasing addenda of quinoline; more powerful regulators, such as "sulphured" quinoline, inhibit the formation of dibenzyl ether. Benzyl alcohol is converted into dibenzyl ether by palladium. The reduction of benzoyl chloride may be represented by the scheme: hydrocarbon $\longleftarrow$ ester $\longleftarrow$ benzoyl chloride $\longrightarrow$ aldehyde $\longrightarrow$ alcohol $\longrightarrow$ ether; any particular member of the series may be made the main product of the change by suitably influencing the catalyst.
H. W.

Non-radiating Atoms. (SIR) JOSEPH LARMOR (*Phil. Mag.*, 1921, [vi], **42**, 595).—The conditions under which an orbital system of electrons does not radiate energy unless disturbed are discussed.
J. R. P.

Escapements and Quanta. (SIR) JOSEPH LARMOR (*Phil. Mag.*, 1921, [vi], **42**, 592—594).—An atom is compared with a clock, the outer electron shell being the pendulum, maintained in continuous vibration by the energy of the core imparted through an unknown escapement mechanism, which parcels out quanta.
J. R. P.

An Atomic Model based on Electromagnetic Theory. I. ALBERT C. CREHORE (*Phil. Mag.*, 1921, [vi], **42**, 569—592).—A mathematical paper. It is shown that the force between two neutral atoms each composed of revolving rings of electrons and stationary charges is not zero on the basis of Saha's theory of the forces (*Physical Rev.*, 1919, **13**, 41). There cannot then be an equilibrium velocity for a ring of electrons, and an atom with stationary electrons is indicated. A model of the hydrogen atom consistent with electromagnetic theory consists of two electrons ($-e$) of the shape of oblate spheroids, one on each side of a smaller positive nucleus ($+2e$) of similar shape, the whole rotating about a common axis. The attractions between such atoms would obey the inverse square law.
J. R. P.

Helium and Hydrogen Models. EDWIN C. KEMBLE (*Science*, 1920, **52**, 581—583).—Closely approximating expressions for the energy of the electrons in Langmuir's model of the helium atom (A., 1920, ii, 656; *Science*, 1920, **52**, 433) are derived from the Wilson-Sommerfeld quantum conditions. Numerical evaluations using Langmuir's data do not give the observed ionisation potential of helium.
CHEMICAL ABSTRACTS.

Scattering of Light in Gases. M. BORN and W. GERLACH (*Zeitsch. Physik*, 1921, **5**, 374—375).—A theoretical paper in which

the scattering of light has been calculated on the basis of the hydrogen, oxygen, and nitrogen models of Bohr and Debye. The depolarisation factor deduced from the figures obtained has been compared with the experimental figures found for this factor by Strutt and Gans. The comparison shows that the order of magnitude is the same in both cases, but neither is there a quantitative agreement nor is the sequence the same for the three models. It is therefore shown that the molecule models do not represent the reality. J. F. S.

The Determination of the Valency Scale of Iron, Cobalt, Nickel, Copper, Manganese, Tin, and Tungsten by means of their Water Vapour Equilibria, and of the Dissociation Pressure of the Oxides of these Metals. LOTHAR WÖHLER and O. BALZ (*Zeitsch. Elektrochem.*, 1921, **27**, 406—419).—Experiments were made to determine the true number of oxides of iron by measuring the equilibrium constants when ferric oxide is reduced by a gradually increasing amount of hydrogen, or, conversely, when iron is oxidised by an increasing amount of water vapour. The equilibrium constant was determined by measuring the concentrations C_{H_2O} and C_{H_2} of water vapour and hydrogen respectively in equilibrium with the solid phase. The apparatus used was similar to that previously described by Wohler and Prager (A., 1917, ii, 455). Only three equilibrium constants were found, corresponding with equilibria Fe_2O_3/Fe_3O_4, Fe_3O_4/FeO, and FeO/Fe, the first being the highest, numerically, and the second the lowest. Since, in the experiments, a known weight of ferric oxide was taken, and known volumes of hydrogen for the reduction, the exact composition of the solid phase could be determined when the value of the equilibrium constant changed. In this way it was shown that the only oxides of iron formed, either by reduction or oxidation, were FeO, Fe_3O_4, and Fe_2O_3. The primary product of oxidation of iron with water vapour at a red heat is FeO, not Fe_3O_4 as has been stated. The values of the equilibrium constants C_{H_2O}/C_{H_2} found were, for Fe_2O_3/Fe_3O_4, 7·5 at 350° to 17·9 at 950°; for Fe_3O_4/FeO, 1·03 at 640° to 5·07 at 950°; for FeO/Fe, 0·62 at 750° to 0·92 at 990°.

The same method was also applied to determining the valency scales of other metals. The highest oxide of cobalt, Co_2O_3 was too unstable for equilibrium determinations. The constants for Co_3O_4/CoO and CoO/Co were determined at 450°, the values being respectively 34·4 and 13·5. No other oxide of cobalt was found. In the case of nickel, the oxide Ni_3O_4 was too unstable for determinations to be made, since it begins to decompose below 450°. The value of the constant for NiO/Ni is about 14·8 at 450°. The so-called nickel sub-oxide is a mixture of NiO and metal. From the fact that Ni_3O_4 is less stable than Co_3O_4 it may be concluded that nickel is nobler than cobalt.

In the case of copper oxides, the following constants were found at 450°: CuO/Cu_2O, 26·3; Cu_2O/Cu, 16·7. In the manganese series the only constant determined was Mn_3O_4/MnO at 450°, 34·6.

Stannous oxide was found to be a stable intermediate stage between tin and stannic oxide, both in oxidation and reduction, the values found being, for SnO_2/SnO, 13·6, and SnO/Sn, 7·9, both at 700°. In the case of tungsten, between tungsten trioxide and the metal, only the bluish-violet W_2O_5 and the brown WO_2 were found as stable phases. The blue oxide with an oxygen value between WO_3 and W_2O_5 is a mixture. The values found were, WO_3/W_2O_5, about 16·0 at 800°; W_2O_5/WO_2, about 5·0 at 800°; WO_2/W, about 1·0 at 950°.

Applying van't Hoff's equation, the heat of reaction for the equation $Fe+H_2O=FeO+H_2$ was calculated from the temperature coefficient of the equilibrium constant, and agreed well with values calculated from other data. In the case of the reaction $3FeO+H_2O=Fe_3O_4+H_2$, the values calculated for the heat of reaction agreed less well, probably because the temperature coefficient of the specific heat of the solid phase introduced an unknown error. The dissociation pressures of the different oxides were also calculated. For the oxides of tin, iron, and tungsten at 1000° these are of the order of 10^{-11} to 10^{-12} mm. of mercury. E. H. R.

New Apparatus for the Generation of Gas. F. Hahn (*Chem. Zeit.*, 1921, **45**, 992).—The numerous forms of apparatus proposed for the generation of gases by the action of liquids on solids are essentially modifications of either Kipp's or Küster's apparatus. Kipp's apparatus has the disadvantage that the acid cannot be completely exhausted, as it is in Küster's apparatus, owing to the mixing of used and fresh acid, whilst Küster's apparatus has the serious disadvantage that, after the gas generated while the apparatus is at rest has been delivered, for some time as much acid must be run in as the volume of the gas delivered, and consequently, when the gas is shut off, the apparatus cannot contain the gas which continues to be generated. These disadvantages are avoided in the new apparatus, which may be of either the Kipp or Küster type. In the former case, the connecting tube from the upper globe is bent slightly to one side and reaches to the bottom of the middle compartment. The middle compartment is connected to the bottom compartment by a tube, the top of which is above the level of the liquid when the apparatus is not in use, and there is a fine orifice somewhat below the upper end of the tube. F. M. R.

Improvements in the Soxhlet Extraction Apparatus. Oskar Hagen (*Zeitsch. angew. Chem.*, 1921, **34**, 499—500).—An improved form of the extraction apparatus described previously (this vol., ii, 104). The syphon is done away with, and the condensed solvent dropping from the condenser is not allowed to accumulate in the extraction cylinder, but flows down immediately into the flask after percolating through the material. By this means extraction can be completed in from one-quarter to two-thirds of the time required by the old apparatus. The outlet from the extraction chamber to the flask is bent into a convolution to serve the double purpose of forming a trap to prevent the vapour from the flask rising through the extraction chamber, and, by means of a two-way

tap situated at the top of the loop, to provide a means of withdrawing for testing purposes a sample of the liquid leaving the extraction cylinder. All joints in the apparatus are ground in, as even the best quality corks yield about 10% of their weight in extractive matter to ether. G. F. M.

Inorganic Chemistry.

Some Negative Attempts to Transmute Elements in accordance with Marignac's views on the Unity of Matter. E. Briner (*J. Chim. physique*, 1921, **19**, 9—10).—The action of an electric arc on iodine vapour and a mixture of helium and hydrogen produced no transmutation, although the temperatures of isolated molecules must have been very high. J. R. P.

Rapid Method for Determining the Density of Air. Gregory P. Baxter (*J. Amer. Chem. Soc.*, 1921, **43**, 1317—1318).—A rapid method for determining the density of the air is described. A sealed globe of known exterior volume is weighed under accurately known conditions of temperature, pressure, and humidity. From the conditions, the density of the atmosphere at the time of weighing and the buoyancy effect of the air on the globe and weights may be calculated. By adding the difference between the buoyancy effect on the globe and on the weights to the weight of the globe in air, the weight of the globe in a vacuum is found. If the globe is weighed in the air under any conditions, the weight of air displaced by the globe in excess of that displaced by the weights is readily found by subtraction from the weight in vacuum. This difference divided by the volume of the globe less the volume of the weights yields the atmospheric density. Numerical examples illustrating the method are given in the paper. J. F. S.

Variations of Density of Atmospheric Air. A. Jaquerod and Ch. Borel (*J. Chim. physique*, 1921, **19**, 11—28).—The variations of density of the air in the region of Neuchâtel follow the Loomis-Morley law. The amplitude of the variations does not usually exceed 0·5—0·6 mg. The same result was found with air taken at 2000—5000 m., but the amplitude is smaller. The explanation which assumes the presence of a heavy gas must be rejected and the presence of ultramicroscopic dust is suggested. J. R. P.

Oxidation of Sulphites in Concentrated Solutions. J. Milbauer and J. Pazourek (*Chem. Listy*, 1921, **15**, 34—38).—Concentrated solutions of sulphites are oxidised slowly but quite constantly at ordinary temperatures by air. (Cf. Lumière and Seywetz, *Rev. gen. chim.*, **7**, 15.) Cobalt sulphate, used in concentrations of 0·01 and 0·001 molar, acts as a positive catalyst for

this reaction. Manganese and copper salts, contrary to results obtained with dilute solutions by Bigelow (A., 1898, ii, 506) and Schilow (A., 1903, ii, 276), are not very active catalysts in concentrated solutions of sulphites. In concentrated solutions 0·5 molar, weak alkalinity of the medium intensifies the oxidation, if no precipitation of the catalysing agent is caused. Strong alkalinity retards the reaction. An acid medium has a similar influence. The rapidity of the reaction increases with rising temperatures.

CHEMICAL ABSTRACTS.

Colloidal Selenium. A. GUTBIER and R. EMSLANDER (*Ber.*, 1921, **54**, [*B*], 1974—1978; cf. Meyer, A., 1913, ii, 1048; Gutbier and Emslander, A., 1914, ii, 264).—Very stable colloidal solutions of selenium may be prepared by the regulated action of concentrated hydrazine hydrate solution on selenium dioxide or gray, crystalline selenium and subsequent dilution of the solutions with water and purification by dialysis. According to the degree of dispersivity, the colour of the solutions varies from intense yellow to blood-red. The dilute solutions are stable at the boiling point, but are readily coagulated by barium sulphate. The action of electrolytes at the atmospheric temperature has been investigated by mixing 2*N*-solutions of them with an equal volume of the dialysed system. Hydrochloric, nitric, sulphuric, selenious, and acetic acids immediately change the yellow colour to pink which becomes violet and then blue when the mixtures are gently warmed, thus indicating the formation of coarser aggregates; ammonia has no effect, sodium hydroxide lightens the colour slightly, whereas barium hydroxide causes immediate separation. The coagulating effect of calcium chloride, barium chloride, and alum is particularly marked, whereas that of sodium and potassium chlorides is weaker. Sodium and potassium carbonates appear to increase the stability of the system. The preparations can be frozen to a blue ice, which melts with complete coagulation. With dilute solutions of selenium, on the other hand, the presence of hydrochloric acid, sodium carbonate, or potassium chloride exerts a protective effect in this connexion which is at a maximum at certain definite concentrations; with more concentrated solutions, however, the optimum effect is less definite.

H. W.

Tellurium Sub-bromide. A. DAMIENS (*Compt. rend.*, 1921, **173**, 583—586).—Tellurium sub-bromide, $TeBr_2$, has now been isolated in the solid state, either by rapidly cooling its vapour in a dry vacuum to $-80°$ or by reduction of the tetrabromide in dry ethereal solution in the dark with finely-divided tellurium. The sub-bromide so obtained is chocolate-brown in colour and is decomposed by water. It is completely soluble in dry ether, but it is unstable in this solution, readily decomposing to give tellurium and tellurium tetrabromide. In ethereal solution it combines with iodine to give *tellurium iodobromide*, which is completely soluble in ether and crystallises from it in red crystals.

W. G.

Oxidation and Luminescence of Phosphorus. II. HARRY B. WEISER and ALLEN GARRISON (*J. Physical Chem.*, 1921, **25**, 349—384; cf. this vol., ii, 248).—The various types of emission of phosphorus during oxidation have been considered historically and experimentally from four points of view, (i) emission of gaseous ions, (ii) emission of penetrating radiations, (iii) emission of phosphorus emanation, and (iv) emission of light. It is shown that gaseous ions are formed during the oxidation of phosphorus, and these account for the conductivity of "phosphorised air." These ions furnish nuclei about which oxides and water vapour condense, forming clouds. The cloud arising from glowing phosphorus contains equal numbers of positive and negative particles if the phosphorus is not charged. Ions are formed in the reaction zone and may be withdrawn by an electric field against a current of air sufficiently rapid to remove oxide particles and ozone. The decomposition of ozone and the action of ultra-violet light are unimportant as sources of ions in "phosphorised air." The luminescence of phosphorus is not changed appreciably by charging the element. Radiations of the nature of radium rays, which penetrate black paper and thin metal plates, are not formed during the oxidation of phosphorus. The darkening of a photographic plate protected from light in the region of glowing phosphorus is due to the action of the vapours of hydrogen peroxide and phosphorous oxide. Ions are formed during the oxidation of phosphorous oxide, and render the surrounding atmosphere a conductor. No evidence was obtained of the formation of phosphorus emanation by the action of moisture on phosphorous oxide. The vapours of phosphorous oxide diffuse readily and when admitted to an electrometer they diffuse throughout the instrument and condense on the insulation. On the addition of moisture, the condensed vapours are converted into acid, which causes a leak across the insulation that is easily mistaken for a gaseous leak due to ionisation. The complete oxidation of phosphorus takes place in two stages, phosphorous oxide being the intermediate product. The first step in the oxidation takes place without the emission of light; the luminescence of oxidising phosphorus is due to the oxidation of phosphorous oxide. Ozone is formed during the oxidation of phosphorous oxide. The failure of certain investigators to detect the formation of ozone in this reaction is due, probably, to the action of phosphorous oxide vapours with the iodine liberated in the usual starch–iodide test. Ozone is formed by the ultra-violet light emitted by glowing phosphorus. J. F. S.

Coagulation of Arsenious Sulphide Sols by Cobaltic Complexes. KICHIMATSU MATSUNO (*J. Coll. Sci. Tokyo*, 1921, **41**, 11, 1—15).—The relationship between the valency of a large number of cobaltammines and their power of coagulating arsenic sulphide sols has been investigated. The effect of ageing of the sol was eliminated by using only such sols as had been kept for a year. The results show that the limiting concentration of the precipitating solution can be expressed by the formula $S_N = S/N^4$, where S_N is

the equivalent concentration of an N valent ion, N the valency of the complex ion, and S the limiting concentration for a univalent ion. This equation may be theoretically deduced from Freundlich's adsorption hypothesis. Using the coagulation method, the author has determined the valency of a number of simple and complex cobaltammine radicles. The chemical changes occurring in aqueous solutions of some of the cobaltammines has been followed by the coagulation method, and the results confirm those obtained in the spectroscopic and conductivity experiments (cf. this vol., ii, 644).

J. F. S.

Metallic Hydrides. I. Alkali Hydrides. FRITZ EPHRAIM and EDUARD MICHEL (*Helv. Chim. Acta*, 1921, 4, 762—781).—The pure hydrides of sodium and potassium have been previously prepared in very small quantities only (Moissan, A., 1902, ii, 136; Elster and Geitel, A., 1910, ii, 379; Keyes, A., 1912, ii, 627). The former is best obtained by leading a rapid stream of hydrogen directly on to the surface of, not into, the metal at such a temperature, above 350°, that a yellow glow is produced, and the hydride is carried away as a white smoke, which is precipitated electrically and filtered through glass wool. At higher temperatures, the vapour is darker owing to volatilisation of metal. Sodium prepared from its azide had no special advantage for this purpose, and negative results were obtained by the use of sodium amalgam or solutions of the metal in liquid ammonia. Potassium hydride was prepared by leading the gas into the metal at 350°. In each case, reaction was facilitated by the presence of metallic calcium. The hydrides of rubidium and cæsium were prepared by heating a mixture of their carbonates with metallic magnesium in hydrogen at 650° for five days and at 580—620° for three days, respectively (cf. Moissan, A., 1903, ii, 367), when 90% and 48% of gas were respectively absorbed. The following are given as the most trustworthy of the results (in mm.) obtained from vapour tension, measurements at intervals of 10° over the ranges of temperatures indicated: Sodium hydride, 300—410°, 15, 17, 21, 27, 38, 55, 87, 136, 201, 285, 396, 540. Potassium hydride, 350—410°, 56, 83, 120, 168, 228, 308, 430; 415°, 509. Rubidium hydride, 370—450°, 100, 114, 130, 160, 200, 253, 322, 424, 567. Cæsium hydride, 340—440°, 78, 100, 126, 160, 202, 256, 317, 402, 503, 630, 787. The results show that there is little or no difference between the values for the different hydrides, and that removal of hydrogen causes some, but no extensive, diminution of the vapour tension, this being less the smaller the atomic weight of the metal, and according with the view that the metal is soluble in the hydride. Previous measurements (Keyes, *loc. cit.*; Troost and Hautefeuille, A., 1874, 767) have really been carried out with such solutions. The results with rubidium and cæsium are quoted with reserve owing to the possibility of the presence of carbon dioxide from the magnesium carbonate formed, although this dissociates very slowly (Marc and Simec, A., 1913, ii, 708); soda-lime was employed to diminish its effect, and the recorded values were quickly attained.

In the case of rubidium, a noteworthy peculiarity, confirmed by repeated observation, consisted in a rapid increase of pressure up to 85 mm. at 230°, followed by a very gradual increase to 100 mm. at 370°, succeeded by rapid increases as above quoted. The reason for this is left indefinite. The results obtained with cæsium hydride are further affected by the considerable sublimation of the metal itself, and also by its solution in the hydride. The latter effect is much more marked in the cases of rubidium and cæsium than in the others. The stability of the pure hydrides increases from cæsium to sodium. J. K.

Alteration of Sodium Carbonate in Air. HUGO DUBOVITZ (*Chem. Zeit.*, 1921, **45**, 890—891).—Commercial sodium carbonate almost always contains a quantity of sodium hydrogen carbonate, the carbon dioxide and water required for the formation of the latter being derived from the atmosphere. After about thirteen days' exposure to air, sodium carbonate may contain from 15 to 20% of the hydrogen carbonate; if the air is very moist and contains a large quantity of carbon dioxide, the conversion of the carbonate into the hydrogen carbonate may be complete. To estimate the amount of sodium hydrogen carbonate in sodium carbonate, a portion of the sample should be heated in a tube connected with a weighed calcium chloride tube; the loss in weight of the two tubes is a measure of the carbon dioxide in the hydrogen carbonate, whilst the gain in weight of the calcium chloride tube is due to the water formed by the decomposition of the hydrogen carbonate and to the moisture in the sample. W. P. S.

Recrystallisation of Metals. The Recrystallisation of Zinc. G. MASING (*Zeitsch. Metallk.*, 1921, **13**, 425—428).—On heating zinc that has been cold-worked, primary recrystallisation of the metal begins immediately throughout the mass without the formation of nuclei. As the temperature rises to 170—190° nuclei of secondary crystals begin to appear in the mass of primary crystals and these gradually increase in number and size if the heating is continued slowly until the whole of the metal consists of a mass of large secondary crystals which are coarser the lower the temperature of formation and the longer the heating. If the metal is subjected to a secondary deformation, the secondary crystal nuclei begin to form at 70°. [Cf. *J. Soc. Chem. Ind.*, 1921, 737A.] A. R. P.

Revision of the Atomic Weight of Zinc. II. Electrolytic Estimation of Zinc in Zinc Chloride. GREGORY PAUL BAXTER and JAMES HALLETT HODGES (*J. Amer. Chem. Soc.*, 1921, **43**, 1242—1251; cf. A., 1916, ii, 327).—The atomic weight of zinc has been redetermined by means of the electrolytic estimation of the amount of zinc in zinc chloride. The method of analysis was the same as that previously used for the analysis of zinc bromide. The zinc chloride used was prepared as follows. Crude zinc was electrolytically transported through a concentrated solution of zinc bromide, and the crystalline sponge of pure zinc thus obtained was thoroughly washed with water and very dilute hydrobromic

acid. It was then immersed in dilute hydrobromic acid and treated with bromine and kept cold. The solution was kept over zinc sponge for three months to remove any traces of cadmium which might be present. The purified solution was fractionally crystallised, using only platinum apparatus. The purest crystals were fused in a platinum boat in a current of nitrogen and hydrogen bromide, dissolved in water, and filtered from traces of carbon and silica. The bromide was crystallised, dried, placed in a quartz boat, and fused in a current of chlorine, and the product used in the analyses. As a mean of eleven analyses, zinc chloride was found to contain 47·970% of zinc, which gives a mean atomic weight 65·372, or, rejecting four relatively low values, 65·379. This value is in good agreement with Richards and Rogers's value 65·376 (A., 1896, ii, 21) and Baxter and Grose's value 65·388 (*loc. cit.*) and indicates that the true atomic weight lies very close to 65·38. J. F. S.

Revision of the Atomic Weight of Cadmium. V. Electrolytic Estimation of Cadmium in Cadmium Sulphate. GREGORY PAUL BAXTER and CARL HENRY WILSON (*J. Amer. Chem. Soc.*, 1921, **43**, 1230—1241; cf. A., 1916, ii, 327).—The atomic weight of cadmium has been redetermined by the electrolysis of anhydrous cadmium sulphate. Preliminary experiments with the hydrated salt showed that this salt generally contains a small amount of water above that required for the composition $CdSO_4,8/3H_2O$, and since such water cannot be removed, the hydrated salt is unsuitable for atomic weight determination. Anhydrous cadmium sulphate was prepared from the hydrated salt by heating at 200° in a current of air for two hours when most of the water was removed, the heating was then continued at 720° in a current of sulphur trioxide until a constant weight was obtained. After cooling, the product was heated at 200° for a further two hours to remove sulphur trioxide. The weighed sulphate was dissolved in water and electrolysed, using a weighed mercury cathode in the same way as previously described (*loc. cit.*). As the result of eleven analyses, the value 112·409 was obtained for the atomic weight, the extreme values being 112·328 and 112·437. The mean of the whole of the work of the author and his collaborators on the atomic weight of cadmium is 112·411. The preliminary experiments on the hydrated salt gave a value 112·04. J. F. S.

Physical Chemistry of the Oxides of Lead. I. The Solubility of Lead Monoxide. SAMUEL GLASSTONE (T., 1921, **119**, 1689—1697).

Theory of Smelting. IV. Equilibrium between Metal-pairs and Sulphur. The System: Copper–Manganese–Sulphur. W. GUERTLER and K. L. MEISSNER (*Metall. u. Erz*, 1921, **18**, 438—443; cf. this vol., ii, 402, 589). On melting manganese with copper sulphide, the mass separates into two layers, the upper consisting of manganese sulphide or of a eutectic of manganese and cuprous sulphides and the lower of pure copper or of mixed

crystals of copper and manganese, according to the proportions of both metals present. Manganese has, therefore, a greater affinity for sulphur than copper, and this affinity is not modified by the addition of iron. Thus, if to a mixture of molecular proportions of cuprous sulphide with 1 atomic proportion of manganese, iron is added, the mass separates into three layers, an upper layer of manganese sulphide, a middle layer of a eutectic mixture of manganese sulphide and iron, and a lower layer of copper more or less mixed with iron. A. R. P.

The Constitution of the Alloys of Copper with Tin. III. and IV. J. L. Haughton (*J. Inst. Metals*, 1921, **25**, 309—330; cf. A., 1915, ii, 689).—A study of the equilibrium diagram of copper–tin alloys containing 30—100% of tin at temperatures below 250° by thermal curves and electrical resistance measurements. The alloy with 30·5% of tin shows no arrest between 150° and 250°. The alloy with 42·8% of tin shows a small arrest at about 190°. The alloy containing 57% of tin shows a greater arrest at 190° and in addition a slight arrest at about 210°. These two arrests are present in alloys containing 59% and 61% of tin. At 63% of tin the 190° arrest is pronounced and the 210° point has vanished and a new one has taken its place at 226°. As the percentage of tin increases the size of the higher arrest increases and the size of the lower arrest decreases, being barely perceptible at 90% of tin. The 210° arrest is not affected by the rate of heating whereas on rapid heating the 190° arrest will not show. After the 190° arrest has been suppressed, slow heating or cooling curves do not again show it until the sample has been annealed. Repeated heating and cooling at a slow rate bring about the disappearance of the 190° arrest from heating curves although it persists on the cooling curve. Electrical resistance measurements confirmed the presence of the 190° and 210° arrests. The arrest at 190° is caused by an allotropic change in the ϵ-constituent. The arrest at 226° is due to the solidification of the eutectic of the constituents ϵ and ζ. The latter is a dilute solid solution of copper in tin. The author cannot explain the cause for the appearance of the 210° arrest. A study of the equilibrium curve between 99 and 100% of tin showed that the solubility of copper falls off slightly with increasing tin content but that the slope of the curve is too small to show in the equilibrium diagram. In an appendix the author discusses the diagrams for copper–tin alloys suggested by other workers. Chemical Abstracts.

Stages in the Recrystallisation of Aluminium Sheet on Heating, and Birth of Crystals in Strained Metals and Alloys. H. C. H. Carpenter and Constance F. Elam (*J. Inst. Metals*, 1921, **25**, 259—280).—By heating for long periods at 220°, and for short periods at 250° and 300°, there is produced a general tarnishing of the surface, a granular structure, and a blurring of the original boundaries of the flattened crystals. The birth of new crystals in the old boundaries takes place in the early stages of recrystallisation at 250° and 300°. The structure obtained

after heating to structural equilibrium at a given temperature appears in two distinct forms. New evidence is offered in support of views already put forward (*ibid.*, 1920, **24**, 83) on the birth of crystals. CHEMICAL ABSTRACTS.

The Function of Water of Crystallisation in the Behaviour of Permutite. A. GÜNTHER-SCHULZE (*Zeitsch. Elektrochem.*, 1921, **27**, 402—406).—Experiments were made to determine whether any relation exists between the water content of the permutite molecule and the mobility of the kation which is expressed in the readiness with which basic exchange takes place. The permutites of the alkali and alkaline-earth metals contain $5H_2O$, and it is generally considered that, of these, three are water of crystallisation and two "water of constitution." Experiments with potassium permutite, however, showed that the water content varies continuously according to the temperature and vapour pressure, and no distinction was found between the first three and the last two molecular proportions. The molecular volume of potassium permutite was determined at different stages of hydration, and it was found that the increase of volume per molecule of water was in proportion to the number of molecules of water added. So long as the permutite is not completely dehydrated, it can again be fully hydrated, but after ignition it takes up only about $1{\cdot}25H_2O$. The permutites of the metals copper, silver, chromium, and aluminium, formed by basic exchange from alkali metal permutites, contain from 6 to $8H_2O$; but when formed from ignited potassium permutite the water deficiency of this persists in the derived permutites. The mobility of the kation does not appear to be influenced by the water content. Ignited potassium permutite comes to the same point of equilibrium with a silver nitrate–potassium nitrate solution, for instance, as the fully hydrated permutite, but equilibrium is reached much more slowly, because, through partial sintering during ignition, the high porosity of the manufactured permutite is lost. The ignited permutite is very similar in character, in fact, to natural zeolites. E. H. R.

Preparation of Colloidal Manganese Dioxide. EUSTACE J. CUY (*J. Physical Chem.*, 1921, **25**, 415—417).—The older methods for preparing colloidal manganese dioxide are enumerated and a new method is described. The method described consists in heating a $N/20$ solution of potassium permanganate to the boiling point and while stirring, adding concentrated ammonia solution at the rate of one drop every three to four minutes, until the solution has passed through a wine-red tint and become deep coffee coloured. At no period of the addition may the solution have a perceptible odour of ammonia. To test the complete absence of permanganate in the brown solution, a little is treated with sodium chloride solution which coagulates the colloidal manganese dioxide and leaves the characteristic colour of permanganate. The product contains only potassium hydroxide as an impurity, and as this substance has no action on the colloid, it may be left in the solution. The colloid is immediately coagulated by contact with paper and

parchment, and is therefore purified with great difficulty. It catalyses the decomposition of hydrogen peroxide and is perfectly stable in the presence of alcohol of all concentrations. J. F. S.

The Electrolytic Production of Sodium and Potassium Permanganates from Ferromanganese. ROBERT E. WILSON, W. GRENVILLE HORSCH, and MERRIL A. YOUTZ (*J. Ind. Eng. Chem.*, 1921, **13**, 763—769).—The electrolytic cells used in these experiments consisted of a cylindrical glass jar containing a porous porcelain cup which served as a diaphragm, the cathode (of 16-gauge sheet iron) being placed in the cup and the ferromanganese anode in the jar outside. Several cells were operated in series across a source of direct current. The circuit also contained an ammeter, a copper coulometer, and a rheostat. Arrangements were made for connecting a voltameter across any individual cell. The temperature of each cell was determined by means of a thermometer placed near to the anode. The average period of a run was five hours. The tabulated results of a large number of experiments are given, from which it is concluded that the most suitable anolyte is a solution of sodium carbonate, which gives a product uncontaminated by manganese, with the best efficiency and with the least expenditure of power. The percentage of manganese in the anode has little effect on the cell voltage, but increased manganese content gives increased current efficiency. With a 40% manganese anode (Spiegeleisen), practically no permanganate is produced. The commercial ferromanganese containing 80% of manganese was found to be the most suitable material. The presence of copper in the anode produced practically no effect, but 2% of cobalt reduced the efficiency almost to zero. The operating temperature should not be higher than about 10—20°, as increase of temperature lowers efficiency, increases the energy consumption, and gives rise to a " skin effect " which causes excessive voltages. A current density of about 6 amperes per sq. dcm. gives the minimum energy consumption. At lower current densities the current efficiency falls rapidly; at higher current densities it rises slowly but is accompanied by increased energy consumption. The effect of all variables such as current density, temperature, anolyte composition, etc., is stated to be due to the variations caused by these factors in the oxygen overvoltage, a high oxygen overvoltage being necessary for high current efficiencies in permanganate production. S. S. A.

Magnetic Determinations of A_0, A_1, A_2, and A_3 Points in Steels containing up to 4·8 per cent. of Carbon. TORAJIRÔ ISHIWARA (*Sci. Rep. Tōhoku Imp. Univ.*, 1920, **9**, 401—415; cf. A., 1913, ii, 222).—The specimens examined numbered twenty-two, and ranged from pure iron to steel containing 4·81% of carbon; the determinations were made by a magnetometric method and with a torsion balance, and the heating was effected in a vacuum. The results obtained are discussed fully, and are recorded in tabular form and also in a series of graphs. W. P. S.

Chemical Equilibrium between Iron, Carbon, and Oxygen. A. MATSUBARA (*Trans. Amer. Inst. Mining Met. Eng.*, 1921, No. 1051, 52 pp.).—An investigation of (1) the equilibrium composition of the gas phase in the system: carbon monoxide–carbon dioxide–iron (containing 2 to 30% of oxygen) at 873°, 1070°, and 1175°; (2) the equilibrium composition of the gas phase in the systems (*a*) carbon monoxide–carbon dioxide–ferrous oxide (saturated with iron)–iron (saturated with ferrous oxide) and (*b*) carbon monoxide–carbon dioxide–ferrosoferric oxide (saturated with ferrous oxide)–ferrous oxide (saturated with ferrosoferric oxide) at several temperatures above 700°; (3) the equilibrium composition of the gas phase in the systems (*a*) ferrous oxide–iron carbide (Fe_3C)–carbon monoxide–carbon dioxide, and (*b*) iron–iron carbide–carbon monoxide–carbon dioxide in the range 700° to 1100°. The specific reactions considered are: (i) $3Fe_2O_3+CO \rightleftharpoons 2Fe_3O_4+CO_2$; (ii) $Fe_3O_4+CO \rightleftharpoons 3FeO+CO_2$; (iii) $FeO+CO \rightleftharpoons Fe+CO_2$; (iv) $2CO \rightleftharpoons C+CO_2$; (v) $3Fe+2CO \rightleftharpoons Fe_3C+CO_2$; (vi) $3FeO+5CO \rightleftharpoons Fe_3C+4CO_2$. The first period of carburising reaction apparently coincides with the latter, and a later period with the former of the last two reactions. There exist also transient equilibria between reactions (v) and (vi), (v) and (iii), (vi) and (iv). Equilibria at lower temperatures occur with a more oxidised form of the solid phase than at higher temperatures, even in the same carburising reaction. The limits of temperature and pressure for carburisation are determined from the experimental data. Above 1300° the carburising action of carbon monoxide does not occur; carburised iron is oxidised to a ferrous oxide–iron solid solution by pure carbon monoxide at 1 atmosphere pressure. Under 1 atmosphere pressure, at 1200°, neither carburisation nor decarburisation occurs in pure carbon monoxide; between 1200° and 1300°, iron containing carbon is decarburised by pure carbon monoxide, but iron containing oxygen may be carburised by the same gas, both reactions ending in the formation of oxygenated carboniferous iron proper to that temperature. Between 695° and 1200° a gas sufficiently rich in carbon monoxide will carburise iron; below 695°, no true carburisation can occur. CHEMICAL ABSTRACTS.

Stereochemical Configuration of the Aquo-triammine and Diammine Cobalt Complex Salts. KICHIMATSU MATSUNO (*J. Coll. Sci. Tokyo*, 1921, **41**, 10, 1—27).—The absorption spectra of aqueous solutions of the eight aquo-cobaltammines,

$$\left[Co\frac{H_2O[1]}{H_2O[2]}en_2\right]Cl_3,2H_2O;\quad \left[Co\frac{H_2O[1]}{H_2O[6]}en_2\right]Cl_3,2H_2O;$$

$$[CoCl(H_2O)_2(NH_3)_3]SO_4;\ [CoCl_2H_2O(NH_3)_3]Cl;$$

$$[CoCl_2(H_2O)_2(NH_3)_2]SO_4H;\ [CoCl(H_2O)_3(NH_3)_2]SO_4,H_2O;$$

$[Co(H_2O)_3(NH_3)_3]Cl_3$ and $[Co(H_2O)_3(NH_3)_3]Cl_3$ have been measured over a wide range of concentrations. The electrical conductivity of six complex cobaltammines has also been measured at intervals over periods of time. From the results, the author has demonstrated the influence of the co-ordinated water molecules and has drawn the configurations of the compounds. Two new complex

compounds have been obtained, trans$[Co(NH_3)_3(H_2O)_3]Cl_3$ and $[Co(NH_3)_3C_2O_4 \cdot NO_3]$. The complex compound prepared by Werner by the action of silver nitrate on $[CoClC_2O_4(NH_3)_3]$ and given the formula $[Co(NH_3)_3C_2O_4(H_2O)_2]NO_3$ is shown to have the formula $[Co(NH_3)_3C_2O_4NO_3]H_2O$. An explanation is given of the substitution reactions of the cobaltammines which have the radicles of strong acids in the nucleus. J. F. S.

Reduction of Chromium and other Difficultly Reducible Metals. H. C. P. WEBER (U.S. Pat. 1373038).—A mixture of chromic chloride with iron is heated to 700—1200° to produce metallic chromium and volatilise ferric chloride. If the iron is sufficiently finely divided, and a relatively low temperature is employed for reduction, chromium is obtained in finely divided form. If solid pieces of iron are used and the reaction takes place below the m. p. of the metals, a coating of chromium is formed on the pieces of iron. If an excess of iron is used and a sufficiently high temperature is employed, an alloy of chromium and iron is produced. Chlorides of chromium and nickel may be similarly reduced together to form alloys or mixtures with each other or with iron. Chromic oxide may be employed and converted into chloride with carbon and chlorine. The reduction process is advantageously carried out in a vacuum or in an inert atmosphere such as nitrogen. Other refractory metallic compounds may be similarly reduced and alloyed. CHEMICAL ABSTRACTS.

The Existence of Gaseous Hydrides of Zirconium and Thorium. ROBERT SCHWARZ and ERICH KONRAD (*Ber.*, 1921, **54**, [*B*], 2122—2133).—The question of the existence of gaseous hydrides of zirconium and thorium is of considerable theoretical interest since, if producible, they would form exceptions to Paneth's rule (A., 1920, ii, 749). The preparation of volatile zirconium hydride has been claimed by Winkler (A., 1890, 1375), but denied by Wedekind (A., 1913, ii, 225), whilst preliminary experiments by Schwarz and Deissler (A., 1920, ii, 42) have pointed to its existence. The formation of thorium hydride is recorded by Klauber and von Mellenheim (this vol., ii, 206). Evidence of the existence of either hydride in the gaseous state has not now been obtained.

The experiments are performed by heating the pure respective dioxides with magnesium, dissolving the products in hydrochloric acid and leading the volatile and dried gases, mixed with purified hydrogen, through a series of strongly ignited Marsh tubes. In general, small mirrors are thus obtained which are shown to consist mainly of silicon; the presence of zirconium or thorium could not be detected in any instance. In addition to silicon hydride, the gases evolved contain small amounts of the hydrides of phosphorus and sulphur.

Reduction of the zirconium dioxide by magnesium is effected in iron crucibles which have been coated internally with an electrolytic deposit of nickel and are provided with a gas-tight iron lid so arranged that a current of hydrogen may be passed through the apparatus. Unsatisfactory results were obtained by heating the

mixture in an electric furnace at about 1000°, or by its ignition by a thermite mixture or magnesium ribbon; satisfactory products are most readily secured by gradually heating the crucible almost to bright redness in a blowpipe flame.

All possible precautions are taken to eliminate the possibility that the non-observance of a metallic mirror is due to the rapid decomposition of the gaseous hydrides before reaching the Marsh tubes. H. W.

Revision of the Atomic Weight of Bismuth. Analysis of Bismuth Chloride and Bismuth Bromide. O. Hönigschmid and L. Birckenbach (*Ber.*, 1921, **54**, [*B*], 1873—1904).—A detailed account of work of a portion of which a preliminary notice has appeared previously (A., 1920, ii, 549).

Two series of analyses of bismuth chloride and bismuth bromide are recorded. In each series, the atomic weight is determined by two independent methods (gravimetric estimation of the ratios $BiCl_3 : 3AgCl$ and $BiBr_3 : 3AgBr$ and nephelometric measurement of the silver haloid dissolved in the mother-liquor and determination of the ratios $BiCl_3 : 3Ag$ and $BiBr_3 : 3Ag$ by gravimetric titration with the aid of the nephelometer). In all, eight independent mean values of the atomic weight are thus obtained, the extreme results being 208·98 and 209·00 on the basis Ag=107·88. The values recorded previously (*loc. cit.*) are rendered slightly uncertain by the subsequent observation that the silver condensing tube used in the preparation of the water was giving small amounts of silver ions to the latter (the effect is due to access of laboratory air) and it is only possible to apply an estimated correction. The mean value of the six most trustworthy series is Bi=208·997 or, in round numbers, 209·00; this is a unit higher than the international value previously adopted. The titrimetric values are regarded as the most trustworthy of all and twenty-two estimations are recorded in which the maximal difference in the individual results is 0·5 : 10000.

The experiments differ from the usual type of such determinations in that, in order to prevent the precipitation of basic bismuth salts, it is necessary to precipitate the chloride and bromide in 3*N*- and 2*N*-nitric acid solution respectively. This is shown to be without effect on the results by a special series of experiments with potassium chloride and bromide.

The recent determinations of the atomic weight of bismuth by Classen and Ney (this vol., ii, 119), which depend on the conversion of bismuth triphenyl to bismuth oxide, are criticised in detail. Recalculation of their figures on the basis C=12·001 and H=1·0077 gives the value Bi=208·91±0·05 which is 0·09 lower than that calculated by the authors. H. W.

Thermal Analysis of Binary and Ternary Alloys. J. Würschmidt (*Zeitsch. Physik*, 1921, **5**, 39—43).—Cooling and heating curves have been produced for bismuth and tin and for a series of alloys of these metals. Similar experiments have been made with a series of ternary alloys of lead, bismuth, and tin and curves produced. The temperature measurements were made

with an iron–constantan thermo-element which made it possible to work with much smaller quantities of material than is usual. In the case of the binary alloys, the complete fusion diagram has been produced, and from this it is shown that the eutectic contains 46 atom % of bismuth and melts at about 140°. In the ternary alloys, the eutectic corresponds with the composition Bi_2SnPb and has a melting point of 96°. J. F. S.

The Chemical Properties of Alloys. G. TAMMANN (*Zeitsch. Metallk.*, 1921, **13**, 406—419).—The physical properties of binary alloys of two metals that form a continuous series of mixed crystals change regularly with varying composition, whereas their chemical properties alter suddenly when the atomic ratio of the metals present exceeds a certain well-defined limit, which may generally be expressed as $n/8$, where n, usually 1, 2, 4, 6, 7, rarely 3 or 5, is the number of atoms of the more noble metal in every 8 metal atoms. Thus, yellow ammonium sulphide blackens, in the cold, all alloys of gold and copper containing less than 50·8% of gold (atomic ratio 2/8 Au), whilst those richer in gold remain untarnished even after four years' immersion. Again, nitric acid dissolves silver completely from gold–silver alloys containing less than 52·5% of gold (atomic ratio 3/8 Au), partly from those containing 52·5—64·6 of gold (atomic ratio 4/8 Au), and not at all from those still richer in gold. Under certain conditions, however, these limits disappear, that is, the atoms of the active component tend to diffuse towards the surface, so that the surface layer falls below the limiting value. In the case of the copper–gold alloys, hydrogen sulphide, which behaves like ammonium sulphide at ordinary temperatures, attacks alloys richer in gold as the temperature rises, until, at 140° it blackens gold containing only 1% of copper. A theoretical explanation of the above phenomena, based on the space-lattice theory of crystal structure, is given in some detail and it is shown that it is possible to prepare what may be called " space-lattice isomerides " of alloys which behave differently towards certain reagents. The electrochemical behaviour of binary alloys may be studied by measuring the *E.M.F.* of cells in which the electrolyte consists of a salt of the more electronegative metal from which one pole is made, whilst the other pole consists of different alloys of the two metals. If the composition of the latter is plotted against the voltage of the cell, the curve obtained for alloys in which inner diffusion takes place (for example amalgams) resembles a hyperbola concave to the axis of composition, whilst that obtained for alloys of metals (for example copper–manganese) which form a continuous series of mixed crystals, in general, runs close to this axis until a certain definite composition is reached, when it rises in a nearly perpendicular straight line to a constant voltage equal to that of a cell in which the poles consist of the two pure metals. Alloys of gold with copper and silver behave somewhat differently, the curve rising, after a certain percentage of gold, in a straight line to the value for pure gold, probably due to the deposition of a fine film of the latter on the surface of the alloy. Two metals that form several series of mixed

crystals, for example zinc and copper, give alloys that yield similar curves as manganese–copper except that there are a number of steps corresponding with the various series of mixed crystals, but these steps do not correspond with any definite atomic ratio between the elements. Gold–copper alloys, when made the anode in an electrolytic cell containing a solution of copper nitrate are attacked without evolution of oxygen if the gold does not exceed 29 atoms %, copper dissolving from the alloy. If the voltage applied to a cell containing a large copper cathode and a small anode of gold–copper alloy is plotted against the amperage the curves for alloys containing 25—28 atoms % of gold show a peculiar double hump, whereas the curves for alloys richer or poorer in gold are roughly parabolic. The decomposition voltage of the series is at a maximum at nearly the same limit as that at which there is no attack by reagents, namely, 27 atoms % of gold, while polarisation is first noticeable with alloys containing 50 atoms % of gold. Alloys containing more gold behave in these two cases like pure gold. A. R. P.

Preparation of Pure Platinum. EDWARD WICHERS (*J. Amer. Chem. Soc.*, 1921, **43**, 1268—1273).—Commerical platinum containing small quantities of rhodium, palladium, and iridium, as well as considerable quantities of iron, tin, and other base metals, may be freed from these impurities by four precipitations of ammonium platinichloride. The method consists in dissolving the metal in aqua regia, removing excess of nitric acid by repeated boiling with hydrochloric acid, and precipitating with ammonium chloride. The precipitate is drained on a Buchner funnel, stirred with a considerable volume of 15—20% ammonium chloride solution, and again drained; the washing is repeated three or four times. The washed precipitate is dried and ignited to sponge in an electrically heated muffle. The sponge is dissolved in aqua regia and the process repeated four times. The amount of platinum left in the mother-liquor does not exceed 1% of the platinum in the precipitate. The final precipitate is ignited to sponge in a porcelain dish over a gas flame, and during the reduction a current of hydrogen is passed over the material. The metal was tested for purity by spectroscopic examination and by measuring its thermo-electric effect against a very pure piece of Heraeus wire. The samples were melted to buttons in an oxy-hydrogen flame on a lime slab and then rolled into ribbons. Spectroscopically, the ribbons were found to be pure except for calcium and very often magnesium, but those which had been prepared by melting in an oxy-hydrogen flame containing an excess of oxygen contained less calcium than those prepared in the ordinary oxy-hydrogen flame. Strips prepared in the ordinary oxy-hydrogen flame gave considerable positive *E.M.F.* values against the standard wire at 1200°, whilst those prepared in the flame with excess of oxygen gave negative values varying from 2 to 38 micro-volts in the same circumstances. The calcium taken up by the platinum is in the form of metal, produced from the lime by the reducing atmosphere. The amount of calcium taken up by the platinum in the above-named circumstances can be considerable,

and in some cases the platinum is alkaline to moist litmus. The purest platinum yet obtained contains 0·0001% of calcium. Melting platinum in magnesia crucibles yields a brittle button which cannot be rolled, and in some cases the button was found to contain 3% of magnesium. J. F. S.

Mineralogical Chemistry.

Nature and Chemical Composition of a Mineral containing Cobalt found at Katanga. A. SCHOEP (*Bull. Soc. chim. Belg.*, 1921, **30**, 207—212).—A colloidal mineral allied to heterogenite (cf. Frenzel, this Journal, 1872, 990) and schulzenite (cf. Maertens, A., 1896, ii, 529) and resembling lustrous anthracite in appearance, has been found embedded in malachite and chrysocolla. Its composition is estimated to be $3Co_2O_3,CoO,CuO,7H_2O$. J. H. L.

The Chemical Constitution of Silicates. B. GOSSNER (*Centr. Min.*, 1921, 513—525).—A theoretical paper in which the author criticises current views as to the chemical constitution of silicates. Attempts to deduce from the chemical composition of a crystal the constitution of the corresponding molecular unit are fallacious. It is pointed out that the existence of complex silicates such as $(SiO_4)_3Al_2Ca_3$ or Si_3O_8AlK at the high temperatures at which the corresponding minerals were formed is most improbable, for the chemical affinities of silica and alumina, slight at ordinary temperatures, diminish at higher temperatures. For similar reasons, the existence in minerals of such radicles as $-Al(OH)_2$ is inconceivable. The author endeavours to show that, by postulating the existence of a limited number of simple stable silicates as molecular individuals, the structure of more complicated silicates can be explained as due to combinations of these. Without inquiring further into the nature of the combination of the simpler silicates to the more complex forms, this may be taken as similar to that existing in crystalline double salt or in solid compounds containing water of crystallisation. The simple silicates postulated are SiO_3Na_2, SiO_3Ca, SiO_3Mg, SiO_2,Al_2O_3, all of which can readily be obtained crystalline from the fused state. When water is a constituent of a silicate crystal, hydroxides such as $Ca(OH)_2$ or $Mg(OH)_2$ may be present, and, in certain circumstances, AlO_2H and AlO_3H_3, both of which are known in the crystalline state. From this point of view the composition of several groups of minerals is discussed, particularly in relation to the paragenesis of the minerals. As an example, in the alkali–lime–silicate group, the following formulæ are given:

Nepheline, $SiO_3Na_2,[SiO_2,Al_2O_3]$.
Leucite, $SiO_3K_2,[SiO_2,Al_2O_3],2SiO_2$.
Albite, $SiO_3Na_2,[SiO_2,Al_2O_3],4SiO_2$.
Anorthite, $SiO_3Ca,[SiO_2,Al_2O_3]$.

These formulæ bring out well the relationships between the minerals of this group, the fact that nepheline and anorthite have sharp melting points whilst the others have not, and that the former pair more readily undergo secondary changes in geological deposits, for instance into zeolites, whilst the others behave as if they were in a sense more saturated. A number of other groups are also discussed. E. H. R.

Analytical Chemistry.

Application of the Immersion Refractometer to the Analysis of Aqueous Salt Solutions. C. A. Clemens (*J. Ind. Eng. Chem.*, 1921, **13**, 813—816).—Where n=the refractive index of solution, n_0=the refractive index of water of the same temperature, and c=grams of solute per 100 c.c. of solution, $n-n_0/c$ is a constant. Thus $c/n-n_0$ is a constant independent of temperature, unaffected by dissociation, hydration, and the formation of complexes, and represents the percentage by volume of salt equivalent to one division of the immersion refractometer scale. In determining the composition of mixtures of two salts, one of known and the other of unknown concentration, the percentage of the salt of known concentration divided by its refractive index factor gives in terms of scale divisions the effect on the refractive index due to that salt, and when this value is subtracted from the refractive index of the solution containing the two salts the remainder is equivalent to the refractive index of the salt of unknown concentration in aqueous solution. In the case of two salts both of unknown concentration the specific gravities of the solutions d_4^{20} were taken and the value for water was subtracted. The values thus obtained were then divided by the respective percentages by volume of salt in the solutions. This gave the effect of the addition of 1% of salt on the density of the solution at 20°. The density of a solution at 20° can be calculated by means of the factors thus obtained by multiplying the factor by the percentage of the salt and adding the value for water. By reversing the process, the percentage of salt can be found from the density. Knowing the refractive index of the solution and of water at the same temperature and d_4^{20} of the solution, the percentage by volume of the two salts can be calculated. S. S. A.

Measurement of Hydrogen-Ion Concentration. G. W. Monier-Williams (*Analyst*, 1921, **46**, 315—324).—The construction of an inexpensive apparatus, and the method of using it for the determination of hydrogen-ion concentrations, are fully described. W. P. S.

Joint Use of Two Indicators in the Titration of Acids and J. L. Lizius (*Analyst*, 1921, **46**, 355—356).—The joint

use of two indicators, phenolphthalein and thymolphthalein, or methyl-red and thymol-blue, is recommended, since the colour changes denote either the approach of the end-point or the fact that the solution has been over-titrated. W. P. S.

Rapid Electroanalysis. ARNOLD LASSIEUR (*Bull. Soc. chim.*, 1921, [iv], **29**, 754—780).—A lecture delivered before the French Chemical Society. W. G.

System of Qualitative Chemical Analysis for the Positive Ions. CLAUD H. HALL, jun. (*Trans. Maryland Acad. Sci.*, 1921, **4**, 8 pp.).—The first group is precipitated by means of red phosphorus instead of by hydrochloric acid; this serves to bring mercury entirely into this group and places all the lead in the second group. Thioacetic acid, or its ammonium salt, is substituted for hydrogen sulphide. In the alkali group, potassium is precipitated by means of phosphotungstic acid. CHEMICAL ABSTRACTS.

Estimation of Water in Alcohols. TH. WIRTH (*Zeitsch. Deut. Oel-Fett. Ind.*, 1921, **41**, 147).—Five grams of calcium hydride granules are covered with xylene (previously dried by boiling with calcium hydride) and the mixture is boiled for a moment to dislodge air adhering to the solid; the air in the flask is displaced by pure dry carbon dioxide. The gas is admitted for the duration of the estimation at the rate of two bubbles per second, the exit tube leading to a gas burette containing potassium hydroxide solution. About 1 gram of the alcohol is drawn into the flask from a dropping funnel which is rinsed with 10 c.c. of xylene. Evolution of hydrogen, half of which is derived from the water according to the equation: $CaH_2+H_2O+CO_2=CaCO_3+2H_2$, begins immediately and is complete in forty-five minutes. CHEMICAL ABSTRACTS.

Estimation of Hydrogen Peroxide by means of Stannous Chloride. SVEN HASSELSKOG (*Svensk. Farm. Tid.*, 1921, **25**, 149—150).—The method for the estimation of hydrogen peroxide proposed by Bertalan (A., 1916, ii, 393) is not trustworthy. There is not a single simple reaction involved as claimed. Two other by-reactions occur, namely: $SnCl_2+xH_2O_2 \rightleftharpoons SnO_2,xH_2O+Cl_2+(x-2)O$ (see Zsigmondy, "Kolloidchemie," 2nd. ed.) and $2HCl+H_2O_2 \longrightarrow 2H_2O+Cl_2$. CHEMICAL ABSTRACTS.

Electrometric Estimation of Bromate, Dichromate, Nitrite, and Chloride Ions. W. S. HENDRIXSON (*J. Amer. Chem. Soc.*, 1921, **43**, 1309—1317; cf. this vol., ii, 411).—A continuation of previously published work (*loc. cit.*). In the present paper the author describes methods for the electrometric titration of the ions named in the title. The estimation of bromate by means of iodide and permanganate is effected as follows: A known excess of iodide solution is placed in the titration vessel, which is fitted with a mechanical stirrer and electrodes as previously described (*loc. cit.*) and sufficient $10N$-sulphuric acid added to make the solution double normal. The bromate solution is then

added in such quantity that about 10% of the iodide is undecomposed. The stirrer is started rotating and when the voltage becomes steady the excess of iodide is determined by titration with potassium permanganate solution. The method is accurate to about 0·08%, and the presence of chlorate ions does not influence the results. Iodide solutions may be directly titrated with bromate solution in the presence of 2*N*-sulphuric acid, the end-point being given by an abrupt rise in the potential. This estimation may be carried out in the presence of hydrochloric acid, but difficulties are experienced which become greater the greater the concentration of the acid and so render the accuracy in the presence of hydrochloric acid doubtful. Iodide may be titrated directly with dichromate in sulphuric acid solution of at least 2*N* strength, if sufficient time is allowed near the end point for the reaction to come to an end. The results in this case are accurate to 1 in 6300. Nitrous acid and nitrites may be estimated by the electrometric method as follows: a known quantity of permanganate solution is placed in the titration vessel, diluted, and 10*N*-sulphuric acid added to make the final concentration 1·5*N* The stirrer is started and the nitrite solution slowly added so as to leave 5—10% of the permanganate unchanged. After about five minutes a known excess of iodide is added and the titration completed with permanganate solution. The method gives results which are equally as good as those obtained by the method of Laird and Simpson (A., 1919, ii, 242). The chloride ion may be estimated by adding an excess of a silver solution to a solution of chloride and stirring to coagulate the precipitate. The solution is filtered into the titration vessel, acidified with sulphuric acid, and treated with a measured excess of iodide solution, the excess of which is determined by titration with permanganate. The results are accurate to 1 part in 750 parts, but the method is involved and long. J. F. S.

Estimation of Sodium Hyposulphite. JAMES HOLLINGSWORTH SMITH (*J. Amer. Chem. Soc.*, 1921, **43**, 1307—1308).—The methods available for the estimation of sodium hyposulphite have been critically investigated with the object of finding a fairly rapid method in which it is unnecessary to ensure complete absence of air. The methods due to Ekker (A., 1894, ii, 479), Fradiss (A., 1900, ii, 44), and to Knecht and Hibbert (A., 1907, ii, 907) are all considered to be unsatisfactory for various reasons; the two first-named methods because of the action of air on the solutions and the last method because of the difficulty of preparing pure solutions of dyes of known composition and of the difficulty of working with solutions of titanous chloride. The method of Seyewetz and Bloch (A., 1906, ii, 578), which consists in oxidising the hyposulphite with an ammoniacal solution of silver chloride, according to the equation $Na_2S_2O_4+2AgCl+4NH_4{\cdot}OH=2(NH_4)_2SO_3+2NaCl+2H_2O+2Ag$, and weighing the silver, suffers from two defects, first the gravimetric procedure is slow, and, secondly, it is inaccurate because of the insoluble impurities in the hyposulphite which are held back by the filter and weighed with the silver. The author has modified

the process so that both defects are removed. The precipitated silver is filtered on a Gooch crucible, washed, and then dissolved in nitric acid and estimated by the Volhard method. A further modification consists in using silver nitrate instead of silver chloride. The modified method is carried out as follows: about 0·4 gram of hyposulphite is placed in a dry beaker and treated with double the theoretical quantity of ammoniacal silver nitrate solution. The hyposulphite dissolves and is immediately oxidised with the precipitation of metallic silver. The solution is filtered without warming on a Gooch crucible and washed free from silver salts with an ammoniacal solution of ammonium nitrate. The crucible is then placed in nitric acid and warmed to dissolve the silver and remove nitrous acid. The crucible is removed and the solution diluted and titrated with $0·1N$-potassium thiocyanate solution. The method is rapid and accurate. J. F. S.

Estimation of Hyposulphites and Sulphoxylates. EDWARD L. HELWIG (*Amer. Dyestuff Reporter*, 1920, **7**, ii, 12—13).—Sodium hyposulphite is added in small quantities from a weighing bottle to 50 c.c. of a standard ammoniacal cupric sulphate solution (50 grams of crystallised copper sulphate and 10 c.c. of concentrated ammonia solution per litre) in a flask through which carbon dioxide is being passed, until the blue colour is discharged. The reaction is: $2CuSO_4+4NH_3+Na_2S_2O_4+2H_2O=Cu_2SO_4+Na_2SO_3+(NH_4)_2SO_3+(NH_4)_2SO_4$. An excess of hyposulphite causes the precipitation of 1/13·68 part of metallic copper. For the analysis of sodium sulphoxylate-formaldehyde ("formopon"), standard copper solution is added from a burette to an aqueous solution of the salt through which carbon dioxide is being passed; the liquid is then boiled and the copper solution added until a faint permanent blue colour is obtained. Basic zinc sulphoxylate-formaldehyde ("formopon extra") is dissolved in ammonia solution and estimated in a similar manner. CHEMICAL ABSTRACTS.

New Procedure for the Estimation of Arsenic. J. CRIBIER (*J. Pharm. Chim.*, 1921, [vii], **24**, 241—246).—A new method for the estimation of small quantities of arsenic is based on the intensifying and fixing action of potassium iodide on the yellow stain produced by hydrogen arsenide on mercuric chloride paper. The similar stains produced by the hydrides of antimony, sulphur, and phosphorus are not altered by potassium iodide in this way. The apparatus consists of a flask fitted with a vertical glass tube about 5 mm. in diameter and 30 cm. long. The lower end in the flask is drawn out to a dropping tube and a hole in the tube about 2·5 cm. from the bottom allows of the egress of the gas. For each estimation 8 grams of zinc and 60 c.c. of 20% sulphuric acid are used, and the arsenical solution, previously oxidised with a few drops of permanganate to convert sulphur and phosphorus compounds into non-reducible sulphuric and phosphoric acids, is added all at once. The lower part of the vertical tube contains a roll of filter-paper about 10 cm. long to absorb moisture carried up mechanically by the gas. The upper part of the tube contains the band of mercuric

chloride paper, 5 mm. wide and 12—15 cm. long, extending to within 2 cm. of the roll of filter paper. When all the arsenic is eliminated, which requires two to six hours or more, the test paper is treated with 10% potassium iodide solution, which, acting specifically on the arsenic stain, turns it brown, and at the same time renders it permanent to light and moisture. The arsenic is estimated by comparison of the stain with those produced by known quantities under similar conditions. From 0·0001 to 0·1 mg. can be estimated by the above procedure. G. F. M.

Estimation of Carbon in Aluminium. J. A. SONDAL (*Tidskr. Kem.*, 1920, **17**, 234—245).—Carbon present in commercial aluminium in amounts varying between 0·012 and 0·087% is estimated by treating the metal with potassium cuprichloride solution and weighing the residue, or by an adaptation of the wet combustion method of Corleis. The oxidising mixture used contained for each gram of aluminium: 15 c.c. of saturated copper sulphate solution, 15 c.c. of saturated chromium trioxide solution, and 60 c.c. of a mixture containing by volume 5 parts of saturated chromium trioxide solution, 75 parts of concentrated sulphuric acid, 20 parts of phosphoric acid, and 35 parts of water. Solution of the metal is rapid and may be too violent at first. CHEMICAL ABSTRACTS.

The Detection of Carbon Monoxide. C. R. HOOVER (*J. Ind. Eng. Chem.*, 1921, **13**, 770—772).—An absorbent, Hoolamite, (U.S. Pats. 1321061 and 1321062), is prepared by mixing together fuming sulphuric acid 53—56%, iodine pentoxide 10·6—12%, and pumice stone 33—35%. At ordinary temperatures carbon monoxide is oxidised by this reagent to carbon dioxide with liberation of iodine, which reacts with excess of sulphur trioxide present to form a green substance indicative of the presence of carbon monoxide, and varying in depth with concentration of the gas. On keeping or gentle warming the green colour changes to orange-yellow and disappears in a few minutes, so that the material can again be used as before until about twelve tests have been made, when the colour produced becomes irregular and a fresh supply of reagent is required. The colour produced in each case is compared with permanent colour standards prepared from a mixture of pumice granules with normal and basic copper acetate and chromium oxide. By this means a quantitative test can be made with gas mixtures containing up to 0·2% of carbon monoxide. Interfering gases such an unsaturated hydrocarbons, hydrogen sulphide, etc., are first removed from a gaseous mixture by passing it through dry active charcoal. 0·005% of carbon monoxide can be detected by passing 500 c.c. of a gas mixture through a glass tube containing a column of Hoolamite 50 mm. × 5 mm. A pocket size detector apparatus has been devised.
S. S. A.

Estimation of Potassium in the Presence of Sodium, Magnesium, Sulphates, and Phosphates. H. ATKINSON (*Analyst*, 1921, **46**, 354—355).—The method depends on the solubility of sodium and magnesium perchlorates, sulphates, and

phosphates in methyl alcohol. The mixture of the salts is evaporated with perchloric acid until fumes of the latter are evolved, a further quantity of the acid is added and the evaporation repeated, and 100 c.c. of methyl alcohol are then added. The mixture is boiled for about one hour, cooled, and, after eighteen hours, the potassium perchlorate is collected on a filter, washed with 50 c.c. of methyl alcohol containing 5% by vol. of perchloric acid, *d* 1·12, and then with 20 c.c. of ethyl alcohol. W. P. S.

Estimation of Sodium, Potassium, Calcium, and Magnesium, in Urine, Blood, and Fæces. FREDERICK F. TISDALL and BENJAMIN KRAMER (*J. Biol. Chem.*, 1921, **48**, 1—12, and 223—232).—Rapid methods are described for the estimation of these metals in blood, urine, and fæces. The quantities of material required for the complete analysis are 7 c.c. of blood, 50 c.c. of urine, and 2 grams of dried fæces. C. R. H.

Methods of Estimating Calcium in the Blood. Experimental Control of the Methods of Jansen and of Marriott and Howland. H. LABBÉ and G. DE TONI (*J. Pharm. Chim.*, 1921, [vii], **24**, 247—255).—The titrimetric method of Jansen (A., 1918, ii, 174) gives results of which the accuracy is by no means proportional to the delicacy and length of the procedure. At least three estimations in each case are necessary in order to obtain a mean value closely approximating to the actual figure, and as each experiment requires 10 c.c. of blood, the amount required is fairly considerable, especially if dealing with children. The colorimetric method of Marriott and Howland (A., 1916, ii, 269; 1918, ii, 21), depending on the decolorisation of ferric thiocyanate by oxalates, is not sufficiently delicate, the variations in intensity of the colour being too slight and the readings therefore more or less arbitrary. The filtration of the minute quantities of calcium oxalate precipitate is also a weak point in the method and may lead to loss. G. F. M.

Behaviour of Ammonium Carbonate towards Magnessium. T. C. N. BROEKSMIT (*Pharm. Weekblad*, 1921, **58**, 1250—1251).—In group analysis, addition of ammonium carbonate causes the precipitation of a double carbonate with magnesium if the solution is not sufficiently dilute. S. I. L.

A New Method for the Evaluation of Zinc Dust. BULLNHEIMER (*Metall u. Erz*, 1921, **18**, 443—446).—The dust is ground until it passes through a 90-mesh sieve; 1 gram is shaken with 20 c.c. of water in a 300 c.c. Erlenmeyer flask, 20 c.c. of sulphuric acid (100 grams per litre) and 25 c.c. of 3% hydrogen peroxide are then added together, and the whole is allowed to remain with occasional stirring for four to eight minutes. The zinc particles should then be all dissolved, leaving only a loose metallic slime of lead, etc. Twenty c.c. of 40% sulphuric acid are then added and the excess of hydrogen peroxide estimated by titration with potassium permanganate solution (15 grams per litre) which has been standardised against sodium oxalate. For exact results, the above

quantities and procedure must be strictly adhered to, the solution of the zinc must not take more than ten minutes and the titration must be carried out immediately after this. A. R. P.

Estimation of Small Quantities of Zinc. M. BODANSKY (*J. Ind. Eng. Chem.*, 1921, **13**, 696—697).—To estimate small quantities of zinc in foods, etc., a weighed portion of the substance is treated with sulphuric acid and nitric acid, incinerated, the ash dissolved in dilute hydrochloric acid, and the solution filtered and evaporated. The dry residue is dissolved in dilute hydrochloric acid, copper is removed as sulphide, and excess of hydrogen sulphide is expelled by boiling the solution; the latter is then neutralised with ammonia, treated with 10 c.c. of 50% citric acid solution, boiled, small quantities of calcium carbonate are added until a precipitate of about 1 gram of calcium citrate has formed and the mixture is treated with hydrogen sulphide. After some hours, the precipitate is collected, washed with 2% ammonium thiocyanate solution, dissolved in hot dilute hydrochloric acid, the solution diluted to 45 c.c. and treated with potassium ferrocyanide solution. The turbidity obtained is compared with that produced by a known amount of zinc under similar conditions. W. P. S.

Gravimetric Analysis. XIX. XXIV. Estimation of Cadmium. II. L. W. WINKLER (*Zeitsch. angew. Chem.*, 1921, **34**, 466—467; cf. this vol., ii, 559).—The cadmium is precipitated as cadmium ammonium phosphate, $Cd(NH_4)PO_4,H_2O$, by the addition of a considerable excess of 20% diammonium hydrogen phosphate solution to a very faintly acid, hot, dilute solution of a cadmium salt containing about 2% of ammonium chloride. The precipitate, initially amorphous, becomes crystalline on keeping for an hour with occasional stirring, and after two hours, or the next morning if desired, it is collected, washed with 50 c.c. of cold, saturated cadmium ammonium phosphate solution, and finally with methyl alcohol, and dried for two hours at 100°, at which temperature the water of crystallisation is not lost. As a further check on the weight, the precipitate may be converted in the pyrophosphate by ignition in a platinum crucible. The corrections to be applied to the weight of $Cd(NH_4)PO_4,H_2O$ obtained are as follows: Weight of precipitate 0·2—0·3 gram, add 0·2 mg.; 0·1 gram, add 0·3 mg.; 0·05 gram, add 0·4 mg.; 0·01 gram, add 1·9 mg. The presence in moderate quantity of other ammonium salts, sodium or potassium chloride, etc., does not appreciably affect the accuracy of the estimation. G. F. M.

Rapid Estimation of Copper or Iron in Aluminium-Copper or Aluminium-Iron Alloys. PIERRE HULOT (*Bull. Soc. chim.*, 1921, [iv], **29**, 836—837).—Two to five grams of the alloy, according to the expected copper or iron content, are treated with cold 20% sodium or potassium hydroxide. The aluminium rapidly dissolves and the iron or copper is deposited. The metallic deposit is washed thoroughly by decantation, dried, and weighed. The results may be confirmed in the case of copper by dissolving the

deposit in nitric acid and estimating the copper electrolytically. In the case of iron, the metal is dissolved in hydrochloric acid and estimated in the usual way by precipitation as ferric hydroxide.

W. G.

The Estimation of Mercury in Organic Compounds. HUGO BAUER (*Ber.*, 1921, **54**, [*B*], 2079—2081).—The method consists in a modification of the procedure proposed by Rupp (A., 1908, ii, 1073) and by Wöber (A., 1920, ii, 333).

The substance (0·2—0·3 gram) is weighed into a wide-necked Jena glass flask provided with a two-holed rubber stopper carrying a small dropping funnel and a glass tube leading to a Peligot tube containing about 5 c.c. of water. Concentrated sulphuric acid (10 c.c.) is run into the flask (if the substance is in aqueous solution it is preferable to add fuming sulphuric acid) followed by hydrogen peroxide solution (30%, 3—5 c.c.), which is added slowly and with constant agitation and intermittent warming until a colourless solution is obtained; this operation is usually complete in a few minutes. The contents of the flask and Peligot tube are rinsed into a small beaker, and concentrated ammonia is added in slight excess, after which the mixture is covered and heated at its boiling point for about three minutes to destroy the Caro's acid formed. Ten c.c. of approximately $N/5$-potassium cyanide solution are added to the cooled mixture, followed by 5 drops of potassium iodide solution (10%). Excess of potassium cyanide is titrated with $N/20$ silver nitrate solution. The titre of the potassium cyanide solution must be determined daily by diluting 10 c.c. of it with water (30 c.c.) adding a few drops of ammonia and potassium iodide, and titrating with $N/20$-silver nitrate. H. W.

Estimation of Metallic Aluminium and of Aluminium Oxide in the Commercial Metal. JULIAN H. CAPPS (*J. Ind. Eng. Chem.*, 1921, **13**, 808—812).—The metal is dissolved in sodium hydroxide or in acid in a special apparatus and the hydrogen liberated is collected in a measuring burette where its volume, temperature, and pressure may be read. The volume of gas is equivalent to unoxidised aluminium, together with whatever iron is present when an acid reagent is used, or with the silicon when sodium hydroxide is used. The amount of the oxide content is calculated by difference from the estimated total aluminium present.

S. S. A.

Separation of Aluminium from Glucinum. HUBERT T. S. BRITTON (*Analyst*, 1921, **46**, 359—366).—A solution of salts of the two metals, containing not more than 0·3 gram of glucina and 0·4 gram of alumina, is evaporated to a volume of about 25 c.c., cooled, and 24% sodium hydroxide solution is added in quantity just sufficient to re-dissolve the precipitated hydroxides. The mixture is then diluted to 500 c.c., boiled for forty minutes, the precipitated glucinum hydroxide collected on a filter, washed, ignited, and weighed. The filtrate is acidified with hydrochloric acid and the aluminium precipitated as hydroxide by the addition of ammonia. W. P. S.

Colorimetric Estimation of Iron in Silicates with Ammonium Thiocyanate. JOSEF MATEJKA (*Chem. Listy*, 1921, **15**, 8—13; cf. Thomson, T., 1885, **47**, 493).—One to 2 c.c. of a standard iron solution (containing ferrous iron equivalent to 0·01 gram of ferric oxide per litre of 0·5% sulphuric acid), 8 c.c. of a mixture of 1 part of 10% nitric acid with 3 parts of 10% citric acid solution by volume, and 8 c.c. of 10% ammonium thiocyanate solution are diluted to the 20 c.c. mark in a colorimetric tube. Two similar tubes contain similar quantities of the same solutions, with the exception of the iron, diluted to about 19 c.c. The solution of the pyrosulphate fusion of the silicate in 0·5% sulphuric acid, having been diluted to 250 c.c., is added drop by drop to one tube until equivalent coloration is attained; on repeating the process, it is necessary that the final volume in the tube should be exactly 20 c.c. It is essential that the thiocyanate should be present in excess, and that its concentration should be the same in both tubes (cf. Tatlock, A., 1888, 90). Potassium sulphate and potassium hydrogen sulphate cause a reduction of the intensity and change the colour from pink to orange. Sodium, magnesium, calcium, and titanium chlorides and aluminium salts have a detrimental effect. The interference of all these salts is, however, inappreciable if the solution to be tested is sufficiently acidified with nitric and citric acids before the addition of thiocyanate. The method is equally as satisfactory as that of Lunge (*Zeitsch. angew. Chem.*, 1886, 3). CHEMICAL ABSTACTS.

A Simple, Exact, and Rapid Electrolytic Estimation of Cobalt in Ammoniacal Solution and its Application to Cobalt Nitroso-β-naphthol. K. WAGENMANN (*Metall u. Erz*, 1921, **18**, 447—449).—Cobalt may be rapidly and accurately deposited electrolytically on a rotating double platinum gauze cathode with a current of 5 amperes from a solution containing 5 grams of ammonium chloride, 30 c.c. of strong ammonia, and not more than 0·1 gram of cobalt as sulphate in a bulk of 125—150 c.c. In order to obtain bright, strongly adhering deposits, the cathode is rotated at 600—1200 revolutions per minute and 0·8—1·0 gram of hydrazine sulphate is added a little at a time during the electrolysis, which is complete in forty to forty-five minutes. Precipitation of cobalt with nitroso-β-naphthol and direct ignition of the precipitate to Co_3O_4 usually yields slightly high results due to inclusion of traces of iron, alumina, and copper, if present. The ignited oxide may be dissolved in fused alkali hydrogen sulphate, and the solution treated with ammonia and ammonium chloride and electrolysed as described above A. R. P.

Volumetric Estimation of Tin with Potassium Bromate. V. VELICH (*Chem. Listy*, 1921, **15**, 5—8, 38—41, 56—59).—The method as proposed by Fichter and Müller (A., 1913, ii, 34) is more fully developed. The reduction of solutions of stannic chloride in preparation for titration is best conducted in a closed flask, provided with a Fresenius stopper, an inlet tube for the addition of liquids, and an inlet tube for the continuous passage of carbon

dioxide. Aluminium is the best reducing agent, but in the estimation of tin in alloys the presence of nickel during the reduction with aluminium aids materially. Metals which are precipitated during the aluminium reduction and do not redissolve in hydrochloric acid are removed by filtration through an asbestos mat under reduced pressure and in an atmosphere of carbon dioxide to prevent re-oxidation. It is best to use a 0·2*N*-solution of potassium bromate, kept in an atmosphere of carbon dioxide, for the titration. Various indicators (oxazines, thiazines, and azines) were tried. Capri-blue (L) is the most suitable for this reaction. The above method gives satisfactory results for the estimation of tin in relatively pure preparations and in alloys if these contain less than 0·3% of iron.

CHEMICAL ABSTRACTS.

Estimation of Vanadium in Ores and Metallurgical Products. R. B. SCHAAL (*J. Ind. Eng. Chem.*, 1921, **13**, 698—699).—From 1 to 5 grams of the ore are boiled with 60 c.c. of hydrochloric acid, 5 c.c. of nitric acid and 2 c.c. of hydrofluoric acid are then added and the mixture is evaporated to dryness; in the case of ferrovanadium, a similar procedure is used to obtain the metal in solution, but the hydrochloric acid is added after the other acids; steel is dissolved in hydrochloric acid and the solution evaporated with the addition of nitric acid. The residue obtained as described is twice evaporated with the addition of hydrochloric acid, then dissolved in hydrochloric acid, and the solution diluted and filtered. The filtrate is treated with 60 c.c. of 15% ammonium phosphate solution and ammonia is added until a precipitate of ferric phosphate is formed; the latter is dissolved in a slight excess of hydrochloric acid, the whole mixture is diluted to 300 c.c., and titrated with standard potassium permanganate solution. W. P. S.

Solidifying Rate of Paraffins. K. FRICKE (*Chem. Zeit.*, 1921, **45**, 891—892).—To ascertain the suitability of solid paraffins for candle-making, the author determines the solidifying rate or period required for a melted paraffin to form a mass sufficiently hard to support a given weight. One hundred grams of the paraffin are melted at 65° and poured into a metal dish, 11 by 6 cm. and 3·5 cm. in depth, and containing a thermometer. As soon as the first signs of solidification are noticed, the time is noted and after a further fifty-five minutes the lower end of an iron rod, 19 cm. square and weighing 205 grams, is placed on the surface of the paraffin 2·5 cm. from the side of the dish. The rod is supported vertically and carries a weight of 2 kilos. If the end of the rod sinks into the paraffin, the test is made again after five minutes, and so on, until the depression made by the rod is negligible. A suitable paraffin will solidify to this consistence within sixty-five minutes.

W. P. S.

Detection and Estimation of Coal-tar Oils in Turpentine. V. E. GROTLISCH and W. C. SMITH (*J. Ind. Eng. Chem.*, 1921, **13**, 791—793).—One hundred c.c. of the turpentine are saturated with hydrogen chloride at a low temperature, the pinene hydrochloride

formed is separated by filtration, and the filtrate is distilled under reduced pressure until about 25 c.c. of distillate have been obtained; any tar-oils (toluene, xylene, and commercial solvent naphtha) present are thus concentrated in this distillate. The latter is added slowly to 100 c.c. of sulphuric acid containing 4% of free sulphur trioxide, the mixture is then heated at 70° for twenty minutes, cooled, diluted with water, and distilled with steam. Pure turpentine yields about 0·5 c.c. of yellow oil, n_D^{20} above 1·500; if mineral oil is present it is recovered at this point and is identified by its odour. When oil ceases to distil, the steam supply is disconnected and the mixture distilled directly, warm water being added drop by drop at such a rate that the temperature of the mixture rises gradually. Hydrolysis of the sulphonated hydrocarbons commences at 115° and the free hydrocarbon distils; the distillation is stopped when the temperature approaches 170°. The volume of oil recovered in the distillate is multiplied by 2·2 to obtain the percentage amount of coal-tar oils in the sample, and these oils may be identified by the usual tests (nitration, etc.). The method is not trustworthy in the case of wood turpentines as the use of high temperatures in the distillation of the wood converts a portion of the terpenes into cyclic hydrocarbons. W. P. S.

Estimation of Volatile Alcohols. AD. GRÜN and TH. WIRTH (*Zeitsch. Deut. Oel-Fett. Ind.*, 1921, **41**, 145—147).—To 0·5 to 1 gram of the sample in a 100 c.c. flask are added 5—10 c.c. of lauryl chloride prepared by distilling a mixture of lauric acid with phosphorus trichloride or pentachloride. The flask is plugged with cotton-wool, kept at about 60° for one-half to three hours, the contents are then shaken with 50 c.c. of water, boiled for one minute, cooled, extracted with ether, the free lauric acid is neutralised, and the ester quantitatively hydrolysed with potassium hydroxide. Simple, readily volatile alcohols can be accurately estimated, but such substances as geraniol and methylnonylcarbinol require to be kept for three hours at 60°. Secondary alcohols the hydroxyl group of which is attached to a ring carbon atom, for example, menthol, and tertiary alcohols do not, however, yield satisfactory results.

CHEMICAL ABSTRACTS.

Estimation of Alcohols and Phenols in Ethereal Oils by Esterification with Pyridine. H. W. VAN URK (*Pharm. Weekblad*, 1921, **58**, 1265—1269).—Verley and Bölsing's method (A., 1902, ii, 54) has been examined for menthol, eugenol, and santal oils. In no case does the method give very exact results, but given conditions under which quick determinations may be made for santal oil and eugenol with fair approximation. S. I. L.

A Method for the Estimation of Sugar in Normal Urine. STANLEY R. BENEDICT and EMIL OSTERBERG (*J. Biol. Chem.*, 1921, **48**, 51—57; cf. also A., 1918, ii, 246).—By elimination, by the use of acetone, of the confusion due to the presence of creatinine, the picric acid method of sugar estimation of Lewis and Benedict (A., 1915, ii, 111) is made applicable to urine. The addition of acetone

destroys the colour produced by creatinine, whilst leaving unaffected that due to the sugar. C. R. H.

Estimation of Lactose in the Presence of other Reducing Sugars. L. LE GRAND (*Ann. Falsif.*, 1921, **14**, 268—269).—In using Barfoed's method (this vol., ii, 355) for the estimation of lactose in milk, the sugar solution should be diluted so that the concentration of alkali or alkaline-earth salts does not exceed 0·1%; when these salts are present in greater concentration, basic salts are precipitated and interfere with the estimation. W. P. S.

Revision of the Optical Method for Analysing Mixtures of Sucrose and Raffinose. C. A. BROWNE and C. A. GAMBLE (*J. Ind. Eng. Chem.*, 1921, **13**, 793—797).—Owing to the change in the Herzfeld divisor of the Clerget formula for estimating sucrose from 142·66 to 143, a revision of the Creydt formula for analysing mixtures of sucrose and raffinose is necessary. On the basis of the invert factor —0·33 for sucrose and +0·514 for raffinose, and 1·852 as the ratio of the specific rotation of sucrose to that of raffinose, the percentages of sucrose (S) and of raffinose (R) in a mixture are found by the formulæ: $S=0{\cdot}514, P-P'/0{\cdot}844$, and $R=0{\cdot}33\ P+P'/1{\cdot}563$, where P and P' are the direct and invert polarimetric readings at 20° of a normal (sucrose) weight solution of the mixture. General formulæ, applicable at all temperatures, are as follows: $S=P(0{\cdot}478\times0{\cdot}0018t)-P'(1{\cdot}006-0{\cdot}0003T)/(0{\cdot}908-0{\cdot}0032t)(1{\cdot}006-0{\cdot}0003T)$ and $R=P(0{\cdot}43-0{\cdot}005t)+P'(1{\cdot}006-0{\cdot}0003T)/(1{\cdot}681-0{\cdot}0059t)(1{\cdot}006-0{\cdot}0003T)$, where T is the temperature of the direct polarisation and t that of the invert polarisation. W. P. S.

The Use of Taka-diastase in Estimating Starch. EDWARD HORTON (*J. Agric. Sci.*, 1921, **11**, 240—257).—The results of much experimental work on the estimation of starch by hydrolysis with taka-diastase are recorded, and show that the method is not always trustworthy. The quantity of enzyme suggested in the original method (Davis and Daisch, A., 1914, ii, 588) seems insufficient. Various commercial samples of the enzyme gave unsatisfactory results, and samples were prepared by the growth of *Aspergillus oryzæ* on sterile bran and on Munter's medium. The activity of the enzyme so prepared increased until the seventh day of growth and then declined. The use of asparagine as the source of nitrogen in the medium tends to produce a more active enzyme. On the whole, laboratory prepared samples gave no better results than commercial ones. Discordant figures are obtained if different classifying agents are used previously to the final sugar estimation. The addition of malt diastase does not increase the total starch figure, but raises the ratio: dextrose/maltose. The cause of the unsatisfactory results is not clear, but although evidence is somewhat conflicting, the theory that it is due to the persistence of dextrins has the greater weight. Control experiments with the enzyme used should be made on pure starch with each set of estimations. Results on this basis are fairly trustworthy. A. G. P.

Precipitation of Solid Fatty Acids with Lead Acetate in Alcoholic Solution. E. TWITCHELL (*J. Ind. Eng. Chem.*, 1921, **13**, 806—807).—The following procedure is recommended for the estimation of solid fatty acids in a mixture of fatty acids. Ten grams of the fatty acids from an oil, or 2 grams of the fatty acids from a fat, are dissolved in 95% alcohol, the solution is boiled, and 1·5 grams of lead acetate dissolved in boiling alcohol are added; the total volume of alcohol used should be 100 c.c. The mixture is cooled slowly to 15°, and, after about eighteen hours, the precipitate is collected on a filter and washed with alcohol until the filtrate ceases to give a turbidity when diluted with water. The precipitate is now dissolved in 100 c.c. of boiling alcohol containing 0·5 c.c. of acetic acid, the solution cooled, and the precipitate again collected, washed, transferred to a separating funnel, and shaken with ether and nitric acid; the ethereal solution is separated, washed, evaporated, and the residue of fatty acids weighed. Fatty acids from different oils yielded the following quantities of solid fatty acids: Cotton-seed oil, 23·13%; soja bean oil, 17·01%; olive oil, 10·93%; earth-nut oil, 16·58%; lard, 40·02%; partly hydrogenated cotton-seed oil, 50·62%; tallow, 53·62%. The iodine value of the solid fatty acids was less than 1·0, except in the case of the hydrogenated cotton-seed oil (42·21) and the tallow (4·38). W. P. S.

Identification of Tartaric Acid in Wines. L. MATHIEU (*Ann. Falsif.*, 1921, **14**, 281—283).—Amyl alcohol extracts a portion of the free tartaric acid from wine, but not potassium hydrogen tartrate or calcium tartrate. Twenty c.c. of the wine are shaken with 20 c.c. of amyl alcohol, the latter is separated and shaken with 20 c.c. of water, and this aqueous extract is evaporated to dryness; the residue obtained is dissolved in 5 c.c. of water and the solution is treated with one drop of calcium chloride solution (15 grams of calcium chloride and 40 grams of ammonium chloride per litre) and 2 c.c. of *l*-ammonium tartrate solution. A precipitate of calcium racemate forms at once if the wine contained 0·5 gram, or more, of free tartaric acid per litre. W. P. S.

Rapid Method for the Estimation of Hippuric Acid in Urine. F. B. KINGSBURY and W. W. SWANSON (*J. Biol. Chem.*, 1921, **48**, 13—20).—The authors describe a modification of the method of Folin and Flanders (A., 1912, ii, 396, 501) for the estimation of hippuric acid, by which, without sacrificing accuracy, the time necessary for the estimation is reduced from nine hours to between two and three hours. C. R. H.

Determination of Watering and Creaming in Samples of Altered Milk. G. ANDOYER (*Comp. rend.*, 1921, **173**, 588—589).—It is shown that the coagulum of sour milk, when freed from fat and mineral matter, contains 15·6% of nitrogen. Thus the method of Kling and Roy for the analysis of samples of sour milk may be modified. The sample, after the addition of a little acetic acid, is filtered on a tared filter and washed with water. The coagulum is dried, extracted with ether, the fat being subsequently recovered and weighed, again dried, weighed, and incin-

erated. In the filtrate and washings the total ash and the soluble nitrogen are determined. From these data the percentages of fat, casein, and ash in the original milk can be calculated and any adulteration detected. W. G.

Detection of Formaldehyde by Resorcinol and Sulphuric Acid. ROBERT COHN (*Chem. Zeit.*, 1921, **45**, 997—998).—Krauss and Tampke's method (A., 1921, ii, 466) for the simultaneous detection of tartaric, oxalic, and formic acids by resorcinol and sulphuric acid has the disadvantage that the reaction is much more sensitive for the detection of tartaric acid than it is for the detection of oxalic or formic acid, and, consequently, it cannot always be applied for the detection of formic acid in food. In order to determine whether the formic acid reaction is influenced by the presence of other organic preservatives which are volatile with steam, the behaviour of formaldehyde with resorcinol and sulphuric acid was examined, and it was found that this reagent is very sensitive for the detection of formaldehyde. Two c.c. of 0·1% aqueous pure resorcinol solution are shaken with an equal volume of the distillate to be tested and about 2 c.c. of concentrated sulphuric acid are then added so as to form a layer below the solution. In the presence of formaldehyde a ring of white flocks with a violet-red coloured base is formed at the junction of the two liquids. After some time, the zone of white flocks increases upwards and a red precipitate, insoluble in water, separates. The reaction is immediate when the solution contains 0·01 gram of formaldehyde per 100 c.c., and is still distinct with only 0·05 mg. of formaldehyde. In the latter case, the violet-red ring may be faint, but the separation of the characteristic white flocks, which increase in quantity on keeping, is distinct. In presence of formic acid, oxalic acid, and tartaric acid, the ring of white flocks with a violet-red coloured base is formed first, although the violet-red colour may be masked by the brown formic acid ring; below this is the blue oxalic acid ring, and when the lower part of the tube is heated carefully, the deep red tartaric acid ring is formed at the bottom. When the test is carried out as described above with other aldehydes or their derivatives, a characteristic zone of white flocks is also produced, but a different coloured ring is formed at its base. Thus, benzaldehyde gives an intense yellow, acetaldehyde deep green, hexamethylenetetramine greenish-brown, and dilute furfuraldehyde solution black-violet. F. M. R.

Separation of Aliphatic Amines from one another and from Ammonia. HARTWIG FRANZEN and ARTUR SCHNEIDER (*Biochem. Zeitsch.*, 1921, **116**, 195—207).—For the investigation of the volatile bases of plants, a method for their quantitative separation is necessary. This can be effected as follows. Ammonium chloride and monomethylamine hydrochloride are insoluble in chloroform, whilst the hydrochlorides of di- and tri-methylamines are soluble. The ammonia and monomethylamine can be separated by addition of yellow mercuric oxide, which, provided the ammonia be not greatly in excess of the methylamine, combines with ammonia

alone. Di- and tri-methylamines can be separated by treatment with iodine in potassium iodide solution, which precipitates the trimethylamine as periodide. H. K.

Behaviour of Nevralteine with Quinine Salts: Easy Method for its Identification. MARIO CARDINI (*Boll. Chim. Farm.*, 1921, **60**, 253—258).—The following reaction has been tested with all the antipyretics at present in use, and is found to be given only by nevralteine (sodium *p*-phenetidinomethanesulphonate): A small quantity (0·02 gram) of the substance and 0·01 gram of quinine hydrochloride or sulphate are treated together in a porcelain dish with a drop of water, a characteristic reddish-yellow coloration being obtained with nevralteine. T. H. P.

Rapid Estimation of Carbamide in Urine, Blood, and other Physiological Fluids. H. STROHMANN and S. FLINTZER (*Zentr. inn. Med.*, 1921, **42**, 545—562; from *Chem. Zentr.*, 1921, iv, 493—494).—An examination of the methods of Folin and his co-workers (A., 1919, ii, 308). Difficulties in the hydrolysis by means of urease may be avoided by using smaller amounts of material (= about 0·2 gram of carbamide nitrogen) and working at greater dilutions. On account of the errors consequent on the small amounts of nitrogen to be estimated, the older method of Marshall (A., 1913, ii, 640) was tried. It gave more concordant results but demanded longer time. Using 10 c.c. of blood filtrate (instead of 5 c.c. as in Folin's method), the liquid may be nesslerised directly after hydrolysis if the same amount of ferment extract is added to the liquid used for comparison. The method to be adopted for the preliminary removal of protein will vary according to the liquid under examinatio an l the amount of protein present. G. W. R.

Typical Reaction for the Differentiation of Carbazole Derivatives. A. V. BLOM (*Helv. Chim. Acta*, 1921, **4**, 625).—A number of examples are quoted to show that the colour developed on the addition of nitric acid to a solution of a derivative of carbazole is characteristic, and serves as an excellent criterion of purity. J. K.

Comparison of Methods for Estimation of Uric Acid in Blood. PIETRO BIFFI (*Riv. osp.*, 11, 29—40; from *Chem. Zentr.*, 1921, iv, 493).—The methods of Ludwig-Salkowski, Schittenhelm-Schneller, Kowarski (piperidine), and Aufrecht (hydroxyl estimation of ammonium urate) for the estimation of uric acid in blood were compared in cases of pathological bloods. The agreement was unsatisfactory, but the first two gave the most concordant results. The second method would appear to be the most trustworthy. A modification of the Kowarski method (precipitation of the proteins by sulphosalicylic acid, transformation by means of ammonium chloride into ammonium urate, and, after washing with ethyl alcohol–acetone, estimation of the ammonia) gave passable results, but was less accurate than the methods first named. G. W. R.

General and Physical Chemistry.

Refractive Indices of Mercury and Thallium Vapours. J. C. McLennan (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 191—200).—The refractive indices of mercury and thallium vapour have been determined for a number of wave-lengths both by the prism method and the interferometer method. A method is described by which interferometer tubes and hollow prisms of clear fused quartz, free from distortion and all trace of devitrification, can be made. These instruments were employed in the present experiments and found to yield satisfactory results. The dispersion curve for non-luminous thallium vapour indicates the existence of anomalous dispersion at the wave-lengths $\lambda\lambda$ 5350·65 and 6000 Å.U. The following values of the refractive index were obtained: mercury vapour at normal pressure and temperature by the interferometer method, λ 4860, μ_0 1·000949; λ 5132, μ_0 1·000943; λ 6110, μ_0 1·000924; λ 6230, μ_0 1·000882; prism method, λ 4358·56, μ_0 1·000942; λ 5460·97, μ_0 1·000902; λ 5780, μ_0 1·000891; λ 6234·31, μ_0 1·000860: thallium vapour at 540°, λ 4358·56; μ 1·000229, λ 4861·49, μ 1·000110; λ 5460·97, μ 1·000293; λ 5769·45, μ 1·000222; λ 5790·49, μ 1·000144; λ 5893, 1·000165; λ 6234·31, μ 1·000309; λ 6563·04, μ 1·000142.

J. F. S.

Hydrogen Spectra from Long Vacuum Tubes. R. W. Wood (*Phil. Mag.*, 1921, [vi], **42**, 729—745; cf. A., 1920, ii, 569).—A continuation of previous work (*loc. cit.*). It is shown that in a tube of great length (190 cm.), containing hydrogen with a suitable trace of water-vapour, the centre of the tube exhibits the Balmer series with the secondary spectrum reduced to 1/50 of its usual intensity. The ends of the tube (to a distance of about 40 cm. from the electrode bulbs) show the secondary spectrum strongly developed in addition to the Balmer series. The phenomena are of the same nature with a continuous current of high potential as with an alternating current; that is, the secondary spectrum develops at both the anode and cathode. With the tube in this condition, the central portion shows a bright flash of the secondary spectrum on closing the switch; the duration of this flash is about 1/50 sec.; on opening the switch the gas recovers its initial condition in about 1/5 sec. and shows the flash again on closing the switch. The secondary spectrum is attributed to molecular hydrogen by Merton, Stark, and others. The first rush of the current appears to break down the molecular hydrogen with the emission of a flash, leaving only atomic hydrogen in the centre of the tube (which gives the Balmer lines). On stopping the current, molecular hydrogen is reformed in about 1/5 sec. The breakdown, however, requires the presence of a trace of water-vapour. A very weak current produces a fairly strong secondary spectrum in the centre

of the tube with the Balmer lines weak or absent. Increase of current weakens the secondary spectrum, which passes through a minimum of intensity as the current becomes stronger and at the same time the Balmer lines increase in intensity. This is probably explained by the fact that molecular hydrogen is reformed as rapidly as it is broken down by a weak current. As the current strength increases the proportion of atomic hydrogen becomes greater with weakening of the secondary spectrum and augmentation of the Balmer lines. This, however, does not go on indefinitely, for with a further increase of current beyond a definite value both spectra increase in intensity at about the same rate. In any case, the percentage of molecular hydrogen cannot be reduced below a certain minimum value. With dry hydrogen and the tube thoroughly free from water-vapour, the Balmer lines disappear entirely from the entire tube (with the exception of a faint trace of H_α). In this stage, a strong group of lines appears in the ultra-violet between the 4th and 5th Balmer lines. When the tube is in this, the white stage, operation with condenser discharges gives a red discharge which shows strongly developed Balmer lines, indicating that momentary currents of several thousand amperes are able to break up molecular hydrogen even in the absence of water-vapour.

J. F. S.

Structure of the Balmer Series Lines of Hydrogen. J. C. McLennan and P. Lowe (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 217—226).—The structure of the Balmer series of hydrogen lines has been examined, using a long discharge tube of the type recently introduced by Wood (A., 1920, ii, 569). The following doublet separations were found for the first four members of the Balmer series, H_α=0·154 Å.U., H_β=0·085 A.U., H_γ=0·062 Å.U., and H_δ=0·049 Å.U. When these separations are plotted against the squares of the corresponding wave-lengths they are shown to lie on a curve which points to the vanishing of the doublet separation at the short wave-length limit of the Balmer series. The lines H_α, H_β, H_γ, and H_δ have been shown to consist of triplets when the electric discharge takes place in hydrogen containing a trace of nitrogen. Experiments made to decide whether the third members of the triplets had their origin in the radiations emitted by nitrogen atoms or in a modification produced by the nitrogen in the radiations emitted by the atoms of hydrogen were not decisive.

J. F. S.

The Balmer Series of Hydrogen, and the Quantum Theory of Line Spectra. Raymond T. Birge (*Physical Rev.*, 1921, **17**, 589—607).—To make as accurate a comparison as possible between the best experimental results for the Balmer series of hydrogen and the theoretical results to be expected according to the latest developments of the quantum theory of line spectra, the experimental data are reviewed and the quantum theory of line spectra, as applied to the Balmer series, is summarised historically. The fine structure of H_α (λ=6563Å) consists of six lines, two of which

are relatively intense, and the author shows that Merton's measurements (A., 1920, ii, 457) of the separation, half-width and relative intensities of the H_α and H_β doublets accord with values derived from the recent Bohr-Kramers developments of the quantum theory, if a general field of 100 volts per cm. is assumed. A discussion of spectral formulæ for the Balmer series indicates (1) that the Rydberg number is not constant for different lines, (2) that this discrepancy between observed and computed results is somewhat reduced by the application of relativity mechanics, and (3) that the discrepancy is obliterated when account is taken of the fine structure of the lines. The Rydberg constant for hydrogen is then calculated to be 106,977·7±0·2 and the Rydberg spectral series constant for a nucleus of infinite mass is computed to be 109,736±0·2. A discussion of observations in mixtures of hydrogen and helium made by Merton and Nicholson (A., 1920, ii, 69) at relatively high pressures concludes the paper. The well known neutral effect of helium on neighbouring electrons together with the Maxwellian distribution of velocities, separations, etc., is quite sufficient to account for the experimental results thus far obtained.

CHEMICAL ABSTRACTS.

Temperature and Band Spectra. W. STEUBING (*Physikal. Zeitsch.*, 1921, **22**, 507—511).—The band spectrum of iodine vapour has been examined in the positive column of a discharge tube at a series of temperatures. The light of the positive column presents at ordinary external temperatures a yellowish-green colour, but as the temperature is raised this passes into a bluish-violet colour. Spectroscopically, it is found that as the temperature is raised the band spectrum diminishes in intensity, at first in the green and then gradually right across the spectrum to the orange, which is observed at 450°, the limit of the experiment. At the same time, the intensity of the continuous spectrum increases, so that it becomes responsible for the bluish-violet colour of the positive column. The loss of intensity of the band spectrum is accompanied by the appearance of a number of lines which become more intensive the more the spectrum loses its characteristic band appearance.

J. F. S.

Spectrum of Ionised Potassium. J. C. MCLENNAN (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 182—190).—The author has photographed the "ground spectrum" of potassium, using electrodeless tubes in which to excite the vapour. The wave-lengths obtained contain the values of 150 lines which were not found by Schillinger (A., 1910, ii, 369), for which an accuracy of 0·5 Å.U. is claimed. In photographing the spectrum with a vacuum spectrograph, wave-lengths were recorded at λλ 1742·2, 1493·4, 1395·4, 1199·7, 1135·0, and 1085·3 Å.U.; of these the first may possibly belong to potassium. The remaining five were also found in the helium spectrum, and may be due to atoms of mercury from diffusion from the pump. The wave-lengths of the enhanced spectrum of potassium, from the point of view of numbers and intensity, fall roughly into two divisions

with a certain amount of overlapping. In one division, the "optical" or "spectral" centre of gravity is approximately at λ=3800 Å.U., and in the other it is in the neighbourhood of λ=2100 Å.U. This suggests a similarity with the ordinary and enhanced spectra of argon, the one with its centre of gravity at 3800 Å.U. corresponding with the red spectrum of argon, and the other to the blue spectrum of this element. J. F. S.

The Electrodeless Discharge in Sodium Vapour. JOHN K. ROBERTSON (*Nature*, 1921, **107**, 269).—A brilliant electrodeless discharge is obtained at a temperature of about 300° when a primary Tesla coil is placed about a highly exhausted pyrex bulb containing metallic sodium, and the whole enclosed in an oven. In addition to the *D*-lines, doublets at 6162 (and 6158), 5688 (and 5683), 4667, and 4497 may be observed, as well as faint probable doublets at 5153, 4980, and 4572. A. A. E.

Emission and Adsorption Spectra of Mercury. J. C. MCLENNAN and W. W. SHAVER (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 200—217).—Using plates stained with dicyanin, the spectra of a number of elements have been photographed in the infra-red region. In the case of mercury, the spectrum was photographed up to λ 11137 Å.U. By the photographic method, as well as by the use of thalofide cells, it has been shown that non-luminous mercury vapour does not absorb radiation of the wave-length λ 10140 Å.U. It has been found that slight and scarcely visible deposits of mercury vapour markedly absorb radiation of the wave-length λ=10140 Å.U., and this result may possibly afford an explanation of the observations made by Dearle (A., 1916, ii, 590; 1919, ii, 126). By the use of thalofide cells (Case, *Physical Rev.*, 1920, 289) and low-intensity mercury arcs, it has been shown that radiation of the wave-length λ=10140 Å.U. may be strongly absorbed by luminous mercury vapour. From the absence of absorption of radiation of wave-length λ 10140 Å.U. by non-luminous mercury vapour, it follows that the atoms of mercury in their ordinary state do not possess a resonance potential of 1·26 volts, corresponding with λ 10140 Å.U., in addition to the well-established one of 4·9 volts, corresponding with λ 2536·72 Å.U. J. F. S.

Revision of Series in the Arc Spectrum of Mercury. HERBERT DINGLE (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 167—181).—The arc spectrum of mercury has been reinvestigated and the lines have been grouped in principal, sharp, diffuse, and fundamental series of quadruplets, a singlet series, and combination lines. Photographs and diagrams of the spectrum are included in the paper. The measurements were all made with a quartz Littrow spectrograph giving a dispersion of 7·9 Å.U. per mm. at λ 2400 and 12·9 Å.U. at λ 2800 and the values, given in the international scale, are claimed to be accurate to 0·03 Å.U. or less. J. F. S.

Anomalous Zeeman Effect and Series System for Neon and Mercury. A. LANDÉ (*Physikal. Zeitsch.*, 1921, **22**, 417—422).—The results of the quantum theoretical analysis of the terms of the Zeeman lines are collected and put forward as spectral combination, polarisation, and intensity rules. The complete series systems of neon and mercury are arranged by means of a principle of selection, of the nature of Sommerfeld's conception of the complete doublets and triplets, and from the arrangement, by means of the rules devised from previous work, the Zeeman type of each series is obtained. The agreement with experimental results as to the number, position, and intensity of the Zeeman components confirms the relationship, between the type separated by a magnetic field and the multiplication of lines without a field, which has been previously deduced on the basis of the quantum hypothesis. J. F. S.

The Electronic Structure of the Heavy Atoms and of their Spectral Lines. A. DAUVILLIER (*Compt. rend.*, 1921, **173**, 647—649).—The method used in the detailed study of the *L*-series of uranium (cf. this vol., ii, 532) has been extended to gold, platinum, iridium, osmium, and tungsten. The variations of certain homologous rays have been followed and six new rays have been isolated. The wave-lengths of the *L*-rays of the elements tungsten to uranium are tabulated. W. G.

The Normal Orbit of the Electron in the Atom of Mercury. A. TERENIN (*Nature*, 1921, **107**, 203).—A photographic method of examining absorption by non-luminous mercury vapour up to λ 11300 Å.U. revealed the absence of a marked absorption at λ 10140, although the pressure of mercury vapour reached one atmosphere. Thus the postulation by Dearle of a second normal orbit in the mercury atom, of which the corresponding ionisation and resonance potentials have never been observed, is unnecessary. A. A. E.

Absorption of Light by Electrically Luminescent Mercury Vapour. E. P. METCALFE and B. VENKATESACHAR (*Proc. Roy. Soc.*, 1921, [*A*], **100**, 149—166).—Experiments are described in which mercury vapour at low pressures, rendered luminous by the passage of small electric currents, is found to exert powerful selective absorption. It is found that, of the series lines, those belonging to the first and second subordinate series of triplets exhibit heavy absorption. The following lines are absorbed: λλ (5461, 4359, 4047), 3342, (3663, 3132, 2967), 5289, 5295, 5308, 3655, 3650, 3126 Å.U. Photometric observations are recorded on the absorption and emission of λ 5461 Å.U. by columns of mercury-vapour of different lengths and carrying different currents. The relation between the ratio (emission/absorption) and the current density is found to be linear. The applicability of the Stewart-Kirchhoff law to bright line radiation is discussed, and it is shown

that the complexity of a line may have a great influence on its absorption. The lines 5461 Å.U. and 4359 Å.U. have been reversed, so as to appear as dark lines on the white light spectrum of a carbon arc and the sun. The reversal of 5461 Å.U. has been studied in detail with a Fabry and Perot étalon and with an échelon spectroscope. J. F. S.

Permanganate Absorption Spectrum: Claim for Priority: Formula for Calculating the Uranium Spectrum. JAMES MOIR (*Trans. Roy. Soc. Sth. Africa*, 1921, **10**, 33—34).—The author claims priority for a formula giving the wave-lengths of the bands of permanganates (A., 1920, ii, 573) over Adinolfi (A., 1920, ii, 721). The formulæ put forward by the two authors differ in form, but reduce to the same expression. From the formula for the absorption spectrum of uranyl salts, $n=1/\lambda=2113+66N$, where $N=0$, 1, 2, 3, or 4 (*loc. cit.*), it is now shown that the bands of non-ionised solid salts may be calculated. Thus the bands of autunite are given by dividing the figures calculated by the above formula by the sixth root of the ratio of the molecular weight of the salt to that of UO_2^{++}. In this case the observed bands are λλ 1945, 2000, 2062, 2128, and 2190, whilst the bands calculated by the formula $n=1/\lambda=(2113+66N)/\sqrt[6]{914/2\times270}=1937+60{\cdot}5N$ are λλ 1937, 1997, 2058, 2118, and 2179. J. F. S.

Two Peculiar Luminescence [Phenomena]. CHR. WINTHER (*Zeitsch. wiss. Photochem.*, 1921, **21**, 45—65).—On illuminating certain preparations of zinc oxide with ultra-violet rays, a luminescence is displayed which slowly increases in intensity to a maximum, and on removing the exciting rays immediately disappears, but a dark, fading period must be present. A weak and transient phosphorescence is shown at the same time. Several liquids when mixed with this variety of zinc oxide display marked constitutive actions on the intensity of the luminescence. When potassium iodide is moistened with 2—5N-hydrochloric acid, it emits a luminescence which lasts for about one second and may be photographed. The wave-length of the luminescence waves lies in the region 300—313 $\mu\mu$. A similar effect may be produced by partly substituting for hydrochloric acid potassium chloride, bromide or iodide, or ethyl alcohol. The optimum mixtures have been determined in each case. Potassium iodide becomes at first more active by the absorption of water-vapour and then much weaker. The optimum effect is observed with a vapour pressure of water of 14·6 mm. at 25°. Inactive preparations are rendered feebly active by absorption of moisture. The phenomenon in all probability depends on a crystallo-luminescence brought about by the potassium chloride. J. F. S.

Decomposition of Hydrogen Peroxide in Ultra-violet Light. GERTRUD KORNFELD (*Zeitsch. wiss. Photochem.*, 1921, **21**, 66—99).—Earlier measurements of the decomposition of hydrogen peroxide by ultra-violet light have shown that the Einstein equivalent law does

not hold for these cases, and further that the velocity of the process is dependent only on the quantity of light absorbed, and not on the concentration of the solution. The present work has as its object the investigation of the above-mentioned points. A series of measurements with non-homogeneous light of unknown wave-length was first made and found to be in keeping with the earlier work, since the velocity of the change is strongly reduced by small additions of acid or alkali. It was also found that a slight dependence of the reaction velocity on the concentration of the peroxide exists. The later experiments were made with light of wave-length 305—316 $\mu\mu$, and in each case the absorption was determined exactly. It is found that with increasing dilution the velocity is increasingly dependent on the concentration; the addition of acid also causes a diminution of the velocity which depends on the amount of acid added. That Einstein's equivalent law does not hold was confirmed, and it is shown that in the most favourable case I $h\nu$ brings about the decomposition of eighty molecules. Assumptions are made as to the mechanism of the process, and these lead to calculated results which agree with the experimental results. J. F. S.

Artificial Disintegration of Light Elements. (SIR) E. RUTHERFORD and J. CHADWICK (*Phil. Mag.*, 1921, [vi], **42**, 809—825).—In previous papers (A., 1919, ii, 256—261; 1920, ii, 541) it was shown that when α-particles were passed through nitrogen, positively charged hydrogen atoms were liberated at high velocities, but an uncertainty remained as to the range of the hydrogen particle. With a new and improved microscope, the authors have now been able to show that the hydrogen particles emitted from nitrogen have a maximum range of 40 cm. of air, whereas the hydrogen particles from gaseous hydrogen or hydrogen compounds have a maximum range of 29 cm. of air, both being produced by α-particles from Radium-*C* of range 7 cm. of air. This proves definitely that the charged hydrogen particles do not come from either gaseous hydrogen or hydrogen compounds present as impurity in the nitrogen. The elements lithium, glucinum, boron, carbon, nitrogen, oxygen, fluorine, sodium, magnesium, aluminium, silicon, phosphorus, and sulphur or a suitable compound have been treated with α-rays from a quantity of Radium-*C* equivalent to 20 mg. of radium at a distance of 3·5 cm. from the zinc sulphide screen. The number of scintillations per minute per mg. activity of the source has been determined at an absorption of 32 cm. of air. It is found that boron, nitrogen, fluorine, sodium, aluminium, and phosphorus give off charged hydrogen atoms with ranges in cm. of air, of *ca.* 45, 40, *ca.* 40, *ca.* 42, 90, and *ca.* 65 cm. respectively. Chlorine, calcium, titanium, manganese, iron, copper, tin, silver, and gold give no particles of a greater range than 32 cm. of air, but no investigation has been made for particles of a range less than 32 cm. of air. In the case of nitrogen, it is shown that the number of particles emitted increases rapidly with the velocity of the α-particles. In the case of aluminium, it is found that the

direction of escape of the particles is to a large extent independent of the direction of the impinging α-particles, nearly as many being expelled in the backward as in the forward direction. The range of the backward particles is less than that of the forward particles; for example, with α-particles of range 7·0 cm. of air, the maximum range is 67 cm. of air for the backward particles but 90 cm. for the forward particles. It is shown that only those elements with an atomic mass of $4n+2$ or $4n+3$, where n is a whole number, give rise to hydrogen atoms. This result is explicable on the hypothesis that these elements are built up from helium and hydrogen nuclei. To account for the liberation of a hydrogen atom at high speed, it is necessary to suppose that the hydrogen nuclei are satellites of the main nucleus. In a close collision, the α-particle is able to give sufficient energy to the satellite to cause its escape at high speed from the central nucleus. The velocity of escape of the hydrogen atom does not seem to be very closely connected with the nuclear charge of the disintegrated element, for the range of the hydrogen atoms from boron (charge 5) is greater than that for nitrogen (charge 7), whilst the range of the hydrogen atom from aluminium (13) is greater than that from phosphorus (14). The above hypothesis assumes that positively charged substances attract one another at the very small distances involved. Such attractive forces must exist to hold the ordinary composite nucleus in equilibrium, and it seems likely that these attractive forces will extend some distance from the nucleus. If this view is correct, the forces on the α-particle are initially repulsive, but change sign very near the nucleus. Hydrogen atoms do not appear to be liberated from aluminium by α-particles of less range than 5 cm. This and the increased number liberated by an increase in the velocity of the α-particle shows that the "disruption" potential of the nucleus by an α-particle, that is, the potential difference required to communicate the same energy to an electron as is possessed by the α-particle, is of the order of six million volts for aluminium. J. F. S.

Production of Radiation and Ionisation by Electron Bombardment in Pure and in Impure Helium. FRANK HORTON and ANN CATHERINE DAVIES (*Phil. Mag.*, 1921, [vi], **42**, 746—773).—An outline of the development of ideas concerning the arrangement of the two electrons in the helium atom is given, starting with the author's determination of the minimum radiation voltage and the minimum ionisation voltage for normal helium (A., 1919, ii, 210). In this connexion, the theoretical deductions of Bohr, Franck, and Reiche (A., 1920, ii, 656), Landé (A., 1919, ii, 309), and Kemble (this vol., ii, 478) are discussed and the experimental work of Compton (A., 1920, ii, 725) and of Franck and Knipping (A., 1920, ii, 72) is considered and criticised. Because of the divergence in the results of the various investigators, the authors' former conclusions have been re-investigated, in a specially designed apparatus, over a wider range of pressures than used before. The new experiments show that in pure helium radiation is produced

by the impacts of electrons with 20·4 volts energy, in confirmation of the authors' earlier conclusions, but in disagreement with the most recent conclusions of Franck and Knipping. A second type of radiation is produced at 21·2 volts, in agreement with Franck and Knipping. The 21·2 volt radiation ionises abnormal helium produced by 20·4 volts electron impacts, and with a relatively high gas pressure the detected effects of ionisation may swamp those of radiation. This result provides an explanation of the ionisation of helium by electrons having less than the normal ionising velocity, which is essentially different from that offered by Compton. Both types of radiation can be absorbed and subsequently re-emitted by normal helium atoms, so that they are passed from atom to atom throughout a volume of the gas. For velocities below the normal ionising velocity, the amount of ionisation produced as the result of electron impacts on abnormal helium atoms, under the experimental conditions, is small in comparison with that resulting from the ionising action of the 21·2 volts radiation. The possibility of the presence of a small quantity of impurity in the helium facilitating the production of radiation at 20·4 volts has been investigated, but no evidence that impurity acts in this way has been obtained. It is concluded that the significance of the experimental results in connexion with theories of the arrangement of the two electrons in the normal helium atom lies in the fact that they indicate that the limitations of the selection principle are not applicable to the fundamental displacements of the outer electron of the helium atom. J. F. S.

***J*-Radiation.** J. A. Crowther (*Phil. Mag.*, 1921, [vi], **42**, 719—728).—The author has investigated the relative absorbability of the primary and secondary *X*-radiations from an aluminium radiator. It is shown that the ratio of the secondary radiation to primary radiation steadily diminishes as the thickness of the absorbing screens is increased. This indicates that the secondary radiation is distinctly more absorbable than the primary. The coefficients of absorption of primary and secondary fluorescent radiations in aluminium have been determined for the radiators paraffin wax, aluminium, and copper. The author shows that the *J*-radiation, unlike the *K*-radiation, consists, not of a group of lines of approximately the same wave-length, but of a considerable number of lines comparatively widely spaced in the spectrum. The *J*-radiations from elements of low atomic number are very weak compared with the *K*-radiations. In the case of copper, the intensity of the hard, fluorescent radiation is about 1/30 of that of the characteristic radiation from the radiator. This indicates that these hard, fluorescent radiations are not easily excited. To excite any given line of the series it is probably necessary that the wave-length of the primary radiation should not be much shorter than that of the line to be excited. The hard secondary radiations produced from aluminium, copper, and paraffin wax probably correspond with different lines in the *J*-spectrum of the elements.

J. F. S.

Explanation of Röntgen Spectra and the Constitution of the Atom. L. Vegard (*Physikal. Zeitsch.*, 1921, **22**, 271—274), Adolf Smekal (*ibid.*, 400—402).—Polemical. In the first paper Vegard replies to Smekal's criticism (A., 1920, ii, 654) of his theories on Röntgen spectra and the constitution of the atom (A., 1919, ii, 129). In the second paper Smekal maintains his earlier position.

J. F. S.

Wave-length of *X*-Rays. Ralph W. G. Wyckoff (*J. Washington Acad. Sci.*, 1921, **11**, 366—373).—A theoretical paper in which it is shown that with the existing knowledge it is impossible to determine definitely the structure of any crystal in advance of a knowledge of the wave-length of *X*-rays. Viewed from this position alone, the problem of the length of *X*-ray waves and of the structures of crystals becomes indeterminate. If the case of sodium chloride be taken as typical, it is shown that there are other structures, beside the commonly-accepted "sodium chloride arrangement," which are in agreement with the present experimental data. As a result of this lack of definiteness, it is emphasised that it is more logical to consider the value of the wave-lengths of *X*-rays as based on the quantum hypothesis. J. F. S.

The Mass Absorption and Mass Scattering Coefficients for Homogeneous *X*-Rays of Wave-length between 0·13 and 1·05 Ångström Units in Water, Lithium, Carbon, Nitrogen, Oxygen, Aluminium, and Iron. C. W. Hewlett (*Physical Rev.*, 1921, **17**, 284—301).—The presentation of new experimental work is preceded by a discussion of the current views of the mechanism of absorption and scattering. The total absorption coefficient of homogeneous *X*-rays, obtained by means of a Bragg spectrometer, was measured for the above-named materials at various wave-lengths. The total mass absorption coefficient was found to be proportional to the cube of the wave-length over certain regions, but in all cases where the above range was entirely covered, the constant of proportionality differed for different ranges of wave-length. The case of hydrogen seems to be an exception, as its total mass coefficient was found proportional to the 9/2 power of the wave-length. This, however, was obtained by combining the results from water and liquid oxygen. The constant with which the cube of the wave-length is multiplied to give the true mass absorption coefficient is found to be approximately proportional to the cube of the atomic number of the absorbing element, except for lithium, indicating that Moseley's law does not hold for that element. The true mass absorption coefficient for iron is apparently not proportional to the cube of the wave-length between 0·70 and 1·05 Å.U. For other elements with wave-lengths less than 0·20 Å.U., these coefficients are smaller than is to be expected from theory if the electron has a diameter of the order of 10^{-13} cm. The lack of this decrease in the coefficients of iron is attributed to a shrinkage in the diameter of the electrons in the atoms on account of a closer packing of the electrons. The mass scattering coefficient

of all the materials studied is less than that given by Thomson's theory. For hydrogen it is approximately twice that for other elements, which is further evidence that hydrogen has twice as many scattering electrons per unit of mass as other elements. For iron this coefficient apparently increases for wave-lengths longer than 0·70 Å.U. CHEMICAL ABSTRACTS.

A Radioactive Quantity requiring a Name. N. ERNEST DORSEY (*J. Washington Acad. Sci.*, 1921, **11**, 381—386).—The author puts forward reasons for introducing a new radioactive quantity. The main reason is to avoid the use of long sentences in expressing the quantity of a radioactive substance used, such as " Radium-*C* corresponding with 1 gram radium." The quantity which the author terms "*r*" is that amount of the material which will produce transformed atoms at the same rate as transformed atoms are produced by 1 gram of radium. The author proposes that either the present definition of the curie be modified to meet the case, or a new unit, termed the *rutherford*, be introduced.

J. F. S.

Application of Anode Rays to the Investigation of Isotopes. G. P. THOMSON (*Phil. Mag.*, 1921, [vi], **42**, 857—867; cf. *Proc. Camb. Phil. Soc.*, xx, 210).—Photographs have been obtained for anode rays showing parabolas corresponding with singly charged atoms of lithium, glucinum, sodium, potassium, calcium, and strontium. Lithium is a mixture of isotopes of atomic weights 6 and 7. The proportions in which these appear in the rays are not constant, there being a tendency for the line at 6 to be sometimes considerably stronger than would be expected from the atomic weight. Glucinum is apparently single, atomic weight 9. If there is an isotope at 10 or 11, it is present in extremely small proportion. The remaining elements could not be resolved with the apparatus used, but calcium must consist of atoms of weight equal to those of either potassium or argon, that is, a so-called "isobar." No trace was found of doubly-charged metallic atoms or of atoms with a negative charge. It seems probable that the mechanism of the anode rays is more analogous to spluttering than to electrolysis. J. F. S.

Branching Relationship for Ra-*C*, Ac-*C*, Th-*C*, and the Disintegration Constant of the *C*″ Products. ELEONORE ALBRECHT (*Chem. Zentr.*, 1921, iii, 516; from *Sitzungsber. K. Akad. Wiss. Wien*, 1919, [2A], **128**, 925—944).—Making use of Marsden and Darwin's (A., 1912, ii, 824) relationship Th-*C*″ : Th-*C*=0·35, the author has determined the corresponding branch relationship for Ac-*C* and Ra-*C*. The *C*″ products were obtained by the recoil method from very active *C* products. From the electrometric measurements, the half life (*T*) has been calculated and the following values have been obtained, Ac-*C*″, *T*=4·76 min., Th-*C*″, T=3·20 min., and Ra-*C*″, *T*=1·32 min. The *C*″ products were collected on a negatively charged brass disk, which was placed above and very close to another plate containing the *C* products. A residual

activity, which is due to a contamination of the C'' plates by Ac($B+C$), Th($B+C$), or Ra-C respectively, is estimated and brought into the calculations, so that a pure disintegration curve of the C'' product is obtained. The branching relationship, Ac-C'' : Ac-C is calculated from the ionising relationship of C'' : C, on the assumption that in the appropriate equations one pair of proportionality factors varies as the ionising action of the α-particles of Ac-C and Th-C, whilst the second pair varies as the absorption coefficients of the β rays of Ac-C'' and Th-C''. The relationships found are Ac-C'' : Ac-C' =99·84 and Ra-C'' : Ra-C=0·0004. J. F. S.

Nomenclature of the Radioactive Families. M. C. Neuburger (*Physikal. Zeitsch.*, 1921, **22**, 247—248).—The author proposes a modified nomenclature for the radioactive families; this includes the terms, principal family, root family, and branch family. The principal families are the uranium and thorium families, and include the whole of the products of disintegration of these elements respectively. The root family, and there is only one, is that portion of the uranium family before the branching into ionium and uranium-Y; it consists therefore of the series $U_1 \longrightarrow U\text{-}X_1 \longrightarrow U\text{-}X_2 \longrightarrow U_2$. There are two branch families, namely, ionium ⟶ the final products, and uranium-Y ⟶ the final products. J. F. S.

States of Iron in Nitric Acid. Joseph Grant Brown (*J. Physical Chem.*, 1921, **25**, 429—454).—The author has measured the *E.M.F.* of cells of the type Fe|HNO_3 soln.||HNO_3(conc.)|Pt, in which, the nitric acid varied between d 1·01 and 1·41 and the iron electrode was sometimes rotated and sometimes still during the measurement. The *E.M.F.* was measured repeatedly from the moment of immersion of the electrode until a steady state was obtained. The surface of the electrode in the motionless experiments was examined microscopically. The results are discussed at length and the author is of the opinion that active iron is ferrous, that is, it sends ferrous ions into the solution, whilst passive iron is ferric. J. F. S.

The Theory of the Pile. Décombe (*Compt. rend.*, 1921, **173**, 834—836).—The author proposes to base the theory of the hydroelectric pile on the proposition that the non-compensated heat developed in a pile in action by the chemical reaction proceeding in it is equal to the Joule heat, ri^2dt, which is developed therein by virtue of its internal resistance r and of the current i which is circulating. This is discussed from a theoretical point of view. W. G.

Potential of the Thallium Electrode and the Free Energy of Formation of Thallous Iodide. Grinnel Jones and Walter Cecil Schumb (*Proc. Amer. Acad. Arts Sci.*, 1921, **56**, 199—236).—Measurements have been made at 25° and 0° of the conductivity and ionisation of thallous nitrate solutions, of the solubility of thallous chloride and of thallous iodide, and of the normal potentials

of the thallium and the iodine electrodes. From the conductivity data the equivalent conductance of the thallium ion was found to be 78·36 mhos at 25° and 41·8 mhos at 0°. The equivalent concentrations of the ionised fractions of thallous chloride and thallous iodide, calculated from the conductivity of saturated solutions of these salts, are, respectively, 0·014094 and 0·000235 at 25°, and 0·006095 and 0·0000587 at 0°. From the potential measurements it has been computed that the normal potential of the thallium electrode is +0·6188 volt at 25° and +0·5885 volt at 0°, and that of the iodine electrode −0·3406 volt at 25° and −0·3399 volt at 0°. From the foregoing results, the following are computed for the reaction: Tl (solid) +0·5 I_2 (solid)=TlI (solid): free energy of formation (A)=125·79 kj. at 25° and 125·48 kj. at 0°; heat of formation (U)=122·11 kj. at 25°. Contrary to the assumptions of earlier investigators, it has been found that a metallic thallium electrode is more negative than a saturated two-phase amalgam electrode by 2·8 millivolts at 25° and 1·8 millivolts at 0°.

CHEMICAL ABSTRACTS.

Electrolysis of Hot Concentrated Sulphuric Acid. HANS HOFFMANN (*Zeitsch. Elektrochem.*, 1921, **27**, 442—445).—The author has electrolysed concentrated sulphuric acid (98·3%) d_4^{18} 1·841 at a series of high temperatures by currents of various strengths. It is shown that at 50°, independently of the current strength, hydrogen, hydrogen sulphide, and sulphur are produced on the cathode, whilst at higher temperatures sulphur dioxide and sulphur are produced and in the neighbourhood of 300° only sulphur is obtained. Oxygen is liberated from the anode at these temperatures. At 200°, the oxygen is mixed with sulphur dioxide, produced from sulphur which has diffused from the cathode chamber, and has been oxidised by the hot sulphuric acid and the nascent oxygen. From 280° upward sulphur dioxide and oxygen are liberated in quantities corresponding with Faraday's law. The gas element $SO_2|O_2$, in consequence of incomplete charging of the electrodes, does not furnish the expected *E.M.F.*, and also the velocity of reaction of the gases is too small for the production of large quantities of current. The technical possibilities of such a cell are regarded as hopeless. The decomposition voltage of hot concentrated sulphuric acid lies near to that of water, that is, higher than the calculated and observed values of the potential difference of the gas element. From this it follows that the primary products of electrolysis are hydrogen and oxygen whilst sulphur dioxide is a secondary product.

J. F. S.

Structure of Metal Electrolytically deposited on Rotating Cathodes. W. E. HUGHES (*J. Physical Chem.*, 1921, **25**, 495—509).—A discussion on the structure of metals which have been deposited electrolytically on rotating cathodes. It is suggested (1) that the polished appearance often observed on the surface of deposits formed on rotating cathodes is due to the smallness of the grains

composing the deposit, (2) that the smallness of grain is a consequence of the constancy of metal concentration at the cathode surface, and (3) that, since mechanical movement can maintain a constant metal concentration, rotation of the cathode operates in that way in the cases of deposits formed on rotating cathodes and not, as has been suggested, by way of burnishing. J. F. S.

Influence of Chlorides on the Decomposition Voltage Curve of Chromic Acid. E. LIEBREICH (*Zeitsch. Elektrochem.*, 1921, **27**, 452—455).—The thin layers of oxide or hydroxide on the cathode which give rise to the periodic phenomena observed during the electrolysis of chromic acid are shown to be colloidal in nature; the oxide is drawn to the cathode just so long as a negative tension lies on it. The addition of chlorides brings about a displacement of two curves which make up the decomposition voltage curve of chromic acid. J. F. S.

Calculation of the Specific Heat of Gases. II. W. HERZ (*Zeitsch. Elektrochem.*, 1921, **27**, 474—475; cf. this vol., ii, 299).—A theoretical paper in which the author has deduced four equations by means of which the difference between the two specific heats of gases may be calculated. The first of these, $C_p - C_v = \gamma / M^{1/3} d^{2/3} (T_k - T)$ in which γ is the surface tension is deduced from the Eötvös rule for non-associated liquids. According to Lorenz (A., 1916, ii, 240), the quotient of the density at the boiling point and the critical density is approximately equal to 2·66, whence the second equation, $C_p - C_v = 0{\cdot}75 d_s / d_k M$, is obtained. The third equation, $C_p - C_v = cL / MT_s^2$, in which c is the boiling-point elevation constant and L the latent heat of vaporisation, is obtained from van't Hoff's boiling-point relationship. The fourth equation is obtained by combining Eötvös's rule with Oswald and Davies's equation, $T_k = (1/K_{20} + 293)/2$ (*Zeitsch. anorg. Chem.*, 1920, **112**, 278). This has the form $C_p - C_v = (1/K_{20} + 273)/MT_k$, in which K_{20} is the coefficient of expansion at 20°. The values of $C_p - C_v$ calculated by each of these equations is compared with the experimentally determined values of twelve substances of widely differing character; a fair agreement is found in all cases. In the first equation, the variations from the accepted value lie between +5·5% and −12%, in the second equation between +6% and −27%, in the third equation between +6% and −21%, and in the fourth equation between +2% and −18%. J. F. S.

Fielding's Formula connecting Critical Temperatures and Pressures. J. NEWTON FRIEND (*Chem. News*, 1921, **123**, 219—220).—The author shows that the formula recently put forward by Fielding (A., 1919, ii, 45) connecting critical temperature with critical pressure has a theoretical basis and may be evolved from the van der Waals equation. The formula has the form $T_c = K\sqrt{p_c} + x$, in which K and x are constants. The author shows that the expression $T_c = 8/R\sqrt{ap_c/27}$ is readily obtained. If now $\sqrt{a}/R$ remains fairly constant, as is quite possible at least for allied elements, the equation may be written $T_c = K\sqrt{p_c}$, where K is a

constant equal to $8\sqrt{\alpha}/R\sqrt{27}$. This expression is the essential feature of Fielding's equation, and since it is not to be expected that $\sqrt{\alpha}/R$ is even approximately constant for all the elements, it is not surprising that Fielding finds notable exceptions to his formula. Hence there is not only a theoretical basis for the formula but also an explanation for the exceptions. J. F. S.

Latent Heat of Vaporisation. J. C. THOMPSON (*Chem. News*, 1921, **123**, 204—206).—On the bases of several unusual assumptions, the author deduces a formula for calculating the latent heat of vaporisation. The formula has the form $P\log_{10}P/10\cdot31\times D^{4\,3}=L$, in which P is the ratio between the density of a liquid and its vapour at the boiling point, and D is the density of the liquid at the boiling point compared with water at 4°. The assumptions made in the deduction of the formula are: (i) molecules do not collide, but pass sufficiently near to each other for the forces of attraction between them to be constantly altering the direction of movement. The forces of attraction probably consist of ordinary gravitational force together with surplus or unsaturated valency force, (ii) molecules are without size, (iii) a liquid is merely a gas under the pressure produced by the attractive force of its molecules, (iv) a solid is a liquid in which the attractive forces of the molecules are different in different directions, (v) a crystalline solid is a solid in which the major attractive forces are all acting in one direction, and the minor forces in another. The values calculated for the latent heat by means of the above formula agree remarkably well with the accepted experimental values; thus: water 536·6 (536·6), ethyl ether, 87·58 (87·4), benzene, 95·21 (96·1), and oxygen, 52·3 (52·0); the accepted values are given in brackets. J. F. S.

Specific Heat of Vapours. Determination of Specific Heat of a Vapour at Constant Pressure, *Cp*. J. C. THOMPSON (*Chem. News*, 1921, **123**, 220—221).—A theoretical paper in which a method of calculating the specific heat of gases at constant pressure is outlined, which, although not theoretically sound, yields fairly correct results. The axioms (i), (iii), (iv) in the preceding abstract and those following are discussed. (*a*) The size of molecules does not in any way influence the volume occupied by a liquid. (*b*) A crystalline solid is so arranged that equal forces always act in the same direction. The growth of a crystal from solution is explained on this hypothesis, as the molecules in separating from solution will attach themselves to the small crystal so that the greater forces act on the greater forces. J. F. S.

Necessity of bringing Concordance into the Thermochemical Data of Organic Compounds. WOJCIECH SWIENTOSLAWSKI (reprint from *Roczniki Chemji*, **1**, 59—103).—The author reviews a large number of thermochemical data of organic compounds and discusses the experimental basis of the results. He maintains that a single organic substance ought to be chosen as the standard of thermochemical data; this substance should be benzoic acid, the heat of combustion of which should be determined

with the greatest precision and the value obtained accepted as an international standard. The value ought to be expressed in calories and not in absolute units, since it is impossible to determine the latter quantity with the necessary precision. Calorimetric bombs should always be standardised by means of this substance, and authors of work in the thermochemistry of organic compounds should always state full details of the standardisation of the bomb so that recalculation of the results may be possible.

J. F. S.

Divergence between Adiabatic and Ordinary [Thermochemical] Measurements. W. SWIENTOSLAWSKI and HELENA I ZOFJA BŁASZKOWSKIE (*Roczniki Chemji*, **1**, 166—170).—The authors have carried out thermochemical measurements under differing conditions; (1) in an ordinary calorimeter in which the temperature of the outer jacket was kept constant; (2) in an ordinary calorimeter in which the evaporation of water was prevented by covering it with a layer of a very slightly volatile liquid; and (3) in an adiabatic calorimeter. The results obtained show that the figure obtained by the measurement of a constant quantity of heat in an ordinary calorimeter differs from the value obtained for the same quantity in an adiabatic calorimeter according to the conditions under which the measurement is made. The difference in the two values varies between $\pm 0{\cdot}03\%$ and $\pm 0{\cdot}46\%$. J. F. S.

Substantive Cotton Dyeing. RUDOLF AUERBACH (*Kolloid Zeitsch.*, 1921, **29**, 190—193).—The velocity of diffusion of a number of substantive cotton dyes into a 4% gelatin jelly has been determined at 20°. The distance to which the dye has diffused was measured after twenty-four, thirty-six, sixty, and eighty-four hours and comparative measurements were made with 0·1, 0·05, and 0·01% solutions of the highly-dispersed crystal-violet. It is shown that dyes which are adsorbed from cold solution, diffuse at an average rate of 3·5 mm. per day from 0·1% solutions, whereas dyes which are adsorbed from warm solutions under the same conditions diffuse at 0·9 mm. per day. Potassium dichromate will also dye cotton, but if the dyed material is washed with either water or alcohol the dichromate is all removed, but in washing with mixtures of alcohol and water it is found that less dichromate is removed as the alcohol concentration increases up to a maximum alcohol concentration of about 65%, after which more dichromate may be washed out. It is suggested that the dispersion of the dichromate is at its minimum in the presence of 65% alcohol.

J. F. S.

The Empirical Formula of Walden and the Theory of Ghosh. (MLLE) H. KADLCOVÁ (*Chem. Listy*, 1921, **15**, 109—110).—The values obtained for the empirical constant of Walden (A., 1920, ii, 598—600) $D\sqrt[3]{v}$ as determined by himself and those resulting from calculations according to Ghosh's theory (T., 1918, **113**, 449; 1920, **117**, 1390) for different degrees of dissociation, although in close agreement, are not identical. Since

a comparison of the results of both Walden and Ghosh leads to the conclusion that for a definite degree of dissociation the value of $D\sqrt[3]{v}$ is a constant, it may also be concluded that an electrostatic attraction really exists in solution between electrolytic ions having charges in agreement with the charge of ordinary electrons. The supposition of Ghosh that strong electrolytes are completely dissociated especially in concentrated solutions does not seem warranted. CHEMICAL ABSTRACTS.

Bragg's Work and the Law of Definite Proportions. A. QUARTAROLI (*Gazzetta*, 1921, **51**, ii, 211—212).—The author replies to Perucca's criticism (this vol., ii, 493) on his previous paper (A., 1920, ii, 602). T. H. P.

Possible Utilisation of the Diagrams of Diffraction of *X*-Rays for the Complete Determination of the Structure of Quartz. CH. MAUGUIN (*Compt. rend.*, 1921, **173**, 719—721).—A discussion of the results obtained by radiograms prepared according to Laue's method with a consideration of their use in calculating the value of the parameters used by Bragg in his definition of the structure of quartz. W. G.

***X*-Ray and Infra-red Investigations of the Molecular Structure of Liquid Crystals.** J. STEPH. VAN DER LINGEN (*J. Franklin Inst.*, 1921, **192**, 511—514).—A thin pencil of *X*-rays has been passed through a thin layer of *p*-azoxyanisole and the pattern produced examined. In the case of the solid substance irregularly placed spots are observed which indicate that the crystalline layer is made up of small crystal units of about 1 mm. cross-section. On heating until the *p*-azoxyanisole is plastic and again examining the pattern, it is found that a point pattern is obtained which gives no indication of the type of the crystal symmetry. On heating further until the anisotropic liquid is obtained, a new type of pattern is observed consisting of a series of faint horizontal lines, which are about 1 mm. broad for those lines which pass through the central spot; further off they are fainter, thinner, and more closely spaced. If this is due to diffraction from parallel layers of lamellar molecules, the spacing between the molecules must be of the order 40 Å.U. The absorption spectra of solid, anisotropic liquid, and amorphous liquid forms of *p*-azoxyanisole and the ethyl ester of *p*-azoxycinnamic acid have been examined for infra-red light. It is shown that in all cases the spectra are alike, hence no change has taken place in the linking of the atoms in the molecule. If changes in the space lattices be due to changes in the molecules of polymorphous substances, then these changes are not due to changes in the radicles, but to a spatial rearrangement of the component parts of the molecules. J. F. S.

The Hydroxyl Ring. H. T. F. RHODES (*Chem. News*, 1921, **123**, 249—250).—A continuation of the author's previous work on the constitution of crystal hydrates (this vol., ii, 255). In the present paper, the constitution of the molecule of crystalline copper

sulphate is considered. The author considers that one molecule of water differs from the remaining four, because on treating the pentahydrate with ammonia, only four molecules of water are replaced by ammonia to form the tetra-amminomonohydrate of copper sulphate, whilst treating the penta-ammino derivative with water all five ammino-groups are replaced by water. It is shown that, with the exception of a few special cases, the hydrates of salts may be classed in four types of different constitution. J. F. S.

Is there Redissolution of Sodium Chloride in the Presence of a Non-congruent Solution submitted to Evaporation? C. RAVEAU (*Compt. rend.*, 1921, **173**, 772; cf. this vol., ii, 31, 386).—A further reply to Rengade (cf. this vol., ii, 93). W. G.

Ionic Synergism. I. Experiments with Congo-rubin. L. MICHAELIS and C. TIMÉNEZ-DIAZ (*Kolloid Zeitsch.*, 1921, **29**, 184—190).—It is shown that in all the work on the influence of ions on the condition of colloids the influence of the ions of the solvent has been disregarded. Experiments have been carried out on solutions of congo-rubin to ascertain the influence of a number of sodium and potassium salts in the presence of known concentrations of hydrogen ions. It is shown that each individual type of kation has an action of characteristic strength on the condition of a colloid, which may be experimentally determined for the hydrogen ion, but can only be determined for the sodium or potassium ion by extrapolation for an infinitely small hydrogen-ion concentration of the solvent. The hydrogen and sodium or potassium ions in mixtures do not influence the activity according to an additive law, but rather according to the law that all combinations of these ions have the same action for which $(\log h_0/h) . (\log i_0/i) =$ constant. In the equation h is the concentration of hydrogen ions and i that of the alkali ions. The significance of h_0 and i_0 is seen as follows: if the condition of the reversible colloid solution is represented by Z, then, for a mixture of hydrogen ions of concentration h and alkali ions of concentration i, $Z=f(h.i.)$. If to change the condition to z in a definite time, a mixture of hydrogen ions, h_z, and alkali ions, i_z, is necessary. Then $h_0 = \lim h_z$ when $i=0$, and $i_0 = \lim i_z$ when $h=0$. h_0 and i_0 are the asymptotes of the hyperbola represented by the equation $(\log h_0/h) . (\log i_0/i) = k$, and have the values $h_0 = 10^{-4 \cdot 02}$ and $i_0 = 10^{-0 \cdot 1}$. The sodium and potassium ions behave in mixtures as though they were of the same type. The combination of calcium and hydrogen ions appears to follow a similar law to that obtaining for the alkali ions. J. F. S.

Dielectric Constants of Colloidal Solutions. RUDOLF KELLER (*Kolloid Zeitsch.*, 1921, **29**, 193—196).—The dielectric constant of a number of colloidal solutions has been determined by Drude's method. It is shown that solutions of hydrated colloids such as gelatin and albumin in certain circumstances exhibit abnormally low dielectric constants, whilst colloidal gold solutions have still lower values. The colloidal solutions which occur in natural organisms and contain electrolytes show occasionally an exceed-

ingly high dielectric constant. The terms acidic and basic lose their classical meaning in non-dissociated and associated solutions, since only dissociated solutions can be acid or basic. Not only dyes, albumin, and amphoteric substances, but also potassium hydroxide and hydrochloric acid in the region of medium dielectric constant are somewhat associated, that is, colloidal; at most they are molecular dispersed and not ion dispersed. They obtain the sign of their charge, not from their internal chemical constitutive properties, but from their relative surface charge toward the dispersion medium. Potassium hydroxide in positively charged toluidine is to be regarded as electro-negative, whilst hydrochloric acid in benzaldehyde is positive. J. F. S.

Colloidal Condition of Sparingly Soluble and Slightly Soluble Substances in Water and other Solvents: Experimental Confirmation of Gibbs's Principle. I. Traube and P. Klein (*Kolloid Zeitsch.*, 1921, **29**, 236—246).—An examination of solutions of sparingly soluble substances such as aqueous solutions of hydrocarbons, alkyl haloids, higher alcohols and aliphatic acids, *i*-amyl alcohol, *i*-butyric acid, aniline, *m*-cresol, lead and calcium sulphates, silver chloride, and silver oxalate, by means of the Tyndall cone and the ultra-microscope, shows that the whole of such substances are partly or entirely colloidally dissolved. It appears to be general that in the solution of easily-soluble substances such as sodium chloride in water the transition from the solid homogeneous phase to the solution takes place in such a way that submicrons exist for a short period in the saturated solution. The above is probably true for solvents other than water; thus a solution of water in benzene or carbon tetrachloride shows a colloidal phase. The very poor surface activity of hydrocarbons and alkyl haloids in stalagometric investigations is to be attributed to the coarse dispersion. The diameter of a larger submicron is of the order 10^{-5} cm., whilst that of an individual molecule is 10^{-8} cm., so that the surfaces stand in the ratio $10^{-10} : 10^{-16}$. Such substances in solutions as submicrons only show greater surface activity, despite the strong Gibbs's positivity, when they are converted into molecules or the densest emulsions. The first case is observed with bases such as atropine and acids such as nonoic acid, and the second with indifferent narcotics such as chloroform. If the Traube narcosis hypothesis is substituted for Gibbs's positivity, then all abnormalities can be explained. It is shown by means of the ultramicroscope that surface active substances accumulate, in accordance with Gibbs's principle, at the interface, oil–water, air–water, and lecithin–water. The fall of concentration increases with the size of the Gibbs's positivity. Gibbs's negative substances do not show this accumulation, for in some cases the concentration decreases in the region of the surface. Sparingly soluble benzene derivatives such as xylidine and cresol are very highly colloidal, a fact which explains the ease with which such substances are adsorbed by charcoal. Investigation of the cataphoresis of such substances shows that the colloidal

particles of aniline, toluidine, xylidine, octoic acid, and nonoic acid migrate to the anode, whilst quinoline migrates to the cathode. Preliminary experiments in the adsorption of poisons by the surface of cells of blood corpuscles, yeast-cells, and bacteria-cells have been made, from which conclusions on the cell-destroying action of these substances may be drawn. J. F. S.

Precipitation of Colloids by Non-electrolytes. PAUL KLEIN (*Kolloid Zeitsch.*, 1921, **29**, 247—250).—The results of experiments on the coagulation of colloids by non-electrolytes are described. It is shown that, in the absence of electrolytes, surface active non-conductors are able to coagulate negatively-charged colloids (suspensoids and emulsoids). In some unpublished work, Traube has shown that suspensions of charcoal and sulphur are coagulated by surface active non-electrolytes as soon as the water is saturated with these substances. The same action is now observed for sols of negatively-charged colloids such as arsenic sulphide, albumin, gold, silicic acid, and mercury sulphide. In these cases, coagulation only takes place when the surface active substance in the finest possible state of division in alcohol solution is added to the colloid. Electro-positively charged sols such as ferric hydroxide and aluminium hydroxide are not coagulated under the above-named conditions. The coagulation of albumin by narcotics is irreversible as long as any of the narcotic remains adsorbed in the albumin. This fact will probably furnish the reason for the harmful and sometimes fatal action of narcotics. Coagulation by sparingly soluble surface active non-conductors probably takes place in two phases. The first phase consists in a reduction of the degree of dispersion by mutual coagulation of two colloids, whilst the second consists in the adsorption of the larger particles on the surface of the separated drops of the non-conductor. This view demands that the primarily-formed colloid of the non-conductor should have a positive charge. J. F. S.

Quantitative Methods of Coagulation for Suspensoids. FRIEDRICH VINCENZ VON HAHN (*Kolloid Zeitsch.*, 1921, **29**, 226—236).—Since the stability of suspensoids is determined almost entirely by means of the coagulation by electrolytes, by one or other of the methods, (*a*) the drop process (Schulze), (*b*) the titration process (Linder and Picton), (*c*) the mixture process, and since different investigators using these methods obtain widely differing results, the author has investigated these and other methods in the case of arsenic sulphide sols. It is shown that the mixture process is the most convenient, but the Schulze precipitation method has the advantage that very little (5 c.c.) of the sol is required for a determination. The titration process is not suitable for quantitative work, because the rate of addition of the electrolyte has a marked influence on the result. The author recommends the use of potassium chloride as a normal electrolyte for such determinations. Since it is quite possible that the electrolyte coagulation method is not suitable in all cases, for example, in the case of very dilute

sols or in those cases where chemical combination occurs between the sol and the coagulating electrolyte, the author has tested other methods of coagulation, which include, (1) the effect of filtration on the sol, (2) effect of boiling, and (3) the effect of an electric current. Filtration influences a sol in the sense of causing an increase of the size of the particles. Particularly in the case of very dilute sols is it possible to obtain trustworthy data on the stability of the sol by making a partition curve of the sediment obtained from a series of successive filtrations. An approximate measure of the stability of a sol can be obtained by placing a drop of the sol on a filter-paper and measuring the ratio of the radius of the surface moistened by the unchanged sol to that of the surface moistened by the dispersion medium. This ratio, termed the "capillary number," is characteristic of the sol. The boiling test of stability is very easily carried out, but the method is not suitable for dilute sols, and is only to be regarded as a confirmatory test to the electrolyte coagulation method, or as a substitute for this in cases where chemical reaction occurs between the electrolyte and the sol. Experiments make it likely that coagulation by boiling depends on an adsorption process at the liquid vapour interface. The time required by a definite current to effect coagulation of a sol can be used as a measure of the stability. J. F. S.

Emulsions. III. Further Investigations on the Reversal of Type by Electrolytes. SHANTI SWARUPA BHATNAGAR (T., 1921, **119**, 1760—1769).

Graphical Representation of certain Heterogeneous Equilibria. A. C. D. RIVETT (*Chem. News*, 1921, **123**, 251—252).—A theoretical paper in which it is shown that the usual method of graphical representation of equilibria in binary and ternary heterogeneous systems often expresses relationships which are in opposition to the principles of the phase rule. A modified method of representation which avoids such anomalies is put forward.

J. F. S.

The Oxidation of Ferrous Salts by Potassium Ferricyanide. M. HANNIK (*Chem. Weekblad*, 1921, **18**, 615—616).—The experiments were made with solutions containing 0·007163 gram-molecule of reagent per litre, in presence of concentrated ammonium thiocyanate solutions; the equilibrium examined was therefore

$$Fe(CNS)_2 + (CNS)' + Fe'''(CN)_6 \rightleftarrows Fe(CNS)_3 + [Fe(CN)_6]''''.$$

The ferric thiocyanate formed or remaining in the solution (the equilibrium position was determined from both end-systems) was determined colorimetrically.

The oxidation of the ferrous salt was found to be almost quantitative, completely so in presence of excess of either reagent (ferrous salt or ferricyanide). The reverse reaction proceeds to a small extent only even in the presence of excess of ferrocyanide. In the

ordinary preparation of Turnbull's blue, the equilibrium is affected by the action of the ferrocyanide formed on the ferrous salt present.

S. I. L.

Landolt's Reaction. II. Some Reactions Analogous to the Landolt Reaction. J. EGGERT and B. SCHARNOW (*Zeitsch. Elektrochem.*, 1921, **27**, 455—470).—It was previously found in the kinetic investigation of the Landolt reaction, which takes place according to the equations, (1) $IO_3'+3SO_3''=I'+3SO_4''$, (2) $IO_3'+5I'+6H^{\cdot}=3H_2O+3I_2$, (3) $I_2+SO_3''+H_2O=SO_4''+2I'+2H^{\cdot}$, that the iodine-ion formation up to the liberation of free iodine takes place according to the equation $t=1/(k_2-k_1)\log_e(1+(k_2-k_1)x/k_1a)$, where k_1 and k_2 are the reaction constants of (1) and (2) respectively. The equation $T=1/(k_2-k_1)\,.\log_e k_2/k_1$ holds for the turning point where all the sulphite-ion has been used up, that is, where $x=a$. The time of the turning point is therefore independent of the concentration of the sulphite-ion, but inversely proportional to the concentration of the iodate-ion. The object of the present investigation is to find whether, by employing other reducing agents than sulphurous acid, the more general case exists, namely, that in which the third partial reaction is also determinative of the time of the turning point. For this purpose, the reducing agents potassium ferrocyanide, arsenious acid, sodium thiosulphate, and hydroxylamine hydrochloride have been examined. It is shown that, with respect of the Landolt reaction, reducing agents may be divided into two groups; to the first of these, thiosulphate and sulphite belong. In these cases, the third reaction takes place more rapidly than the second all through the process, that is, at the turning point the reducing agent is all used up. Ferrocyanide and arsenite constitute the second group, and in these cases the third reaction may proceed more slowly than the second, that is, at the turning point only a portion of the reducing agent has been used. Hydroxylamine is a particular case in which the second reaction proceeds more rapidly than the first, and in consequence the Landolt effect is not observed. In the case of the reducing agents in the second group, the equation $t=1/(k_2-k_1)\,.\log_e\{1+(k_2-k_1)x/k_1a\}$ again holds, with the difference that at the turning point x is no longer equal to a but $x=na$, where n is a fraction representing the ratio between the amount of reducing agent used to the original quantity added. The experiments with these reducing agents show that the time of the turning point is independent of the initial concentration of the reducing agent, but inversely proportional to the iodate-ion concentration. Despite the fact that the whole of the reducing agent has not been used at the turning point, the Landolt effect is exhibited. The theory of the reaction demands, (1) that n shall be constant, (2) that the constants k_1 and k_2 shall be proportional to the iodate-ion concentration, and (3) that the velocities at the turning point are proportional, (*a*) for constant iodate-ion concentration, to the ferrocyanide-ion concentration, and (*b*) for constant ferrocyanide-ion concentration, to the iodate-ion concentration. These demands are fulfilled in

the case of ferrocyanide-ion and arsenite-ion. Whilst the constants k_1 and k_2 are of the same order in the ferrocyanide reaction, the mean relationship k_2/k_1 is $8{\cdot}4\times10^{-3}$ in the arsenite reaction, that is, the second reaction is 8000 times as rapid as the first. In the reaction between the iodate-ion and the thiosulphate-ion, the main reaction products are the sulphate-ion and the tetrathionate-ion, which demands a new method of calculating k_1 and k_2 and furnishes a new confirmation of the theory. Along with the ions named, an undetermined oxidation product of the thiosulphate is produced which reacts slowly with iodine to form sulphate. In consequence of the small amount (1·2%) of this product, the mechanism of the reaction is only slightly influenced. In the reaction between the iodate-ion and the hydroxylamine-ion, iodine is separated on mixing the reagents, but the blue coloration of the starch only takes place when the velocity of reaction $2NH_3{\cdot}OH^{\bullet}+2I_2=N_2O+H_2O+6H^{\bullet}+4I'$ has become great enough to raise the iodine concentration to 10^{-6} gram per litre, that is, to the smallest amount recognisable by starch solution. The delayed blue coloration does eventually appear even in this case, but for quite other reasons, so that this reaction cannot be included in either of the other groups. J. F. S.

Intra-molecular Energy during Combustion. W. T. DAVID (*Phil. Mag.*, 1921, [vi], **42**, 868—870; cf. A., 1920, ii, **82**, 731; this vol., ii, 85).—A continuation of previously published work. In the present paper, the pre-pressure period and the explosion period of coal gas explosions are considered. The pre-pressure period is the interval between the time at which the igniting spark passes and that when the pressure commences to rise. In this interval, a considerable amount of gentle ignition occurs, but there is no rise of pressure. In the cases considered, the number of molecules after explosion is about 3% less than before combustion, consequently the translational energy of the freshly-formed molecules during this period is not greater than that of the molecules before ignition. There is no appreciable radiation emitted in this period. In the early stage of the explosion period, the pressure rises slowly, indicating that combustion is proceeding slowly and a small but appreciable radiation is emitted. The radiation of longer wave-length up to about 11 μ is emitted first, and then is accompanied by radiation of shorter wave-length. This is attributed to a moderated combustion being succeeded by a more vigorous combustion. In the later stages of the combustion period, combustion proceeds more violently, as is evidenced by a rapid rise in pressure, and in this period the ratio of infra-red radiation transmitted through quartz (up to 3·5 μ) to that transmitted through fluorite (up to 11·0 μ) is 0·55 for a 15% coal-gas mixture, 0·52 for a 12½% mixture, and 0·46 for a 10% mixture. These results show that the more vigorous the combustion the greater the proportion of short infra-red radiation emitted and therefore the greater the proportion of energy acquired during this period by the vibratory degrees of freedom corresponding with the short

wave-length radiation relatively to that acquired by those degrees corresponding with radiation of greater wave-length.

J. F. S.

The Limiting Pressure of Autoxidation. W. P. JORISSEN (*Rec. trav. chim.*, 1921, **40**, 539—541; cf. A., 1919, ii, 62; this vol., ii, 99).—A critical review of the conclusions drawn by Weiser and Garrison (this vol., ii, 248) in which it is pointed out that as Centnerszwer (A., 1913, ii, 1052) has shown that phosphorus volatilises into pure oxygen at ordinary pressures, the explanation of the limiting pressure put forward by these investigators is not valid. An alternative interpretation of their seventh experiment is given, which is consistent with the author's conception of limiting pressure.

H. J. E.

The Rate of Hydrolysis of Methyl Acetate by Hydrochloric Acid in Solutions containing Sucrose. GEORGE JOSEPH BURROWS (T., 1921, **119**, 1798—1802).

Catalysis [of the Decomposition] of Hydrogen Peroxide by Colloidal Manganese Dioxide. A. LOTTERMOSER and R. LEHMANN (*Kolloid Zeitsch.*, 1921, **29**, 250—260).—The velocity of decomposition of hydrogen peroxide by colloidal manganese dioxide in the presence of a number of neutral salts and bases has been examined at 30°. The manganese dioxide was prepared in the hydrogen peroxide solution by the action of an alkali hydroxide on potassium permanganate. It is shown that the reaction is very sensitive to accidental impurities, and also that the velocity depends on the order in which the reagents are added to the water in which the reaction takes place. In the present experiments, the reagents were added in the order: hydrogen peroxide, potassium permanganate, alkali. The electrolyte the influence of which is being studied was always added to the water before the reacting substances. The assumption that the increase in the velocity constants is to be explained by the formation and subsequent decomposition of a hydrogen peroxide salt could not be confirmed. The influence of the kations of the added salts, which all have the same anion, follows the lyotrope series $Ba^{\cdot\cdot} > Sr^{\cdot\cdot} > Ca^{\cdot\cdot} > Na^{\cdot} > K^{\cdot} > Li^{\cdot}$, in which $Ba^{\cdot\cdot}$ accelerates the reaction to the greatest extent and $Li^{\cdot}$ retards it the most. At higher concentrations, barium falls after calcium. $Mg^{\cdot\cdot}$ and $NH_4^{\cdot}$, on account of the reduction of the hydroxyl ion which they produce, strongly retard the reaction.

J. F. S.

Catalytic Hydrogenation of Organic Compounds by Base Metals at the Atmospheric Temperature. V. Influence of the Nature and Position of the Halogens in Organic Haloid Compounds on the Removal of Halogen by Catalytic Hydrogenation. C. KELBER (*Ber.*, 1921, **54**, [*B*], 2255—2260).—The rate of absorption of hydrogen by a solution of a gram-millimol of the substance in an excess of aqueous potassium hydroxide

solution in the presence of 3 grams of nickel catalyst has been examined in the cases of chloro-, bromo-, or iodo-acetic acids, phenylchloroacetic, phenylbromoacetic, α-bromopropionic, *o*-, *m*-, and *p*-chloro-, bromo-, and iodo-benzoic acids, *o*-, *m*-, and *p*-chlorophenol, *o*- and *p*-bromophenol, *p*-iodophenol, and the chlorocresols. The rate of removal of the halogen by catalysis increases with increasing atomic weight of the halogen, and is in general more readily effected with aromatic than with aliphatic compounds. The distinction between the two classes of compound is less obvious with increasing atomic weight of the halogen. In aromatic compounds in which a second substituent is present, the halogen atom in the ortho-position is least readily and that in the para-position most easily replaced by hydrogen. H. W.

Formation of Elements and Structure of the Atomic Nucleus. EMIL KOHLWEILER (*Physikal. Zeitsch.*, 1921, **22**, 243—246).—A theoretical paper in which, on the basis of the hypothesis previously put forward by the author (A., 1920, ii, 610, 615, 744), and certain emendations necessitated by the recent work of Aston and Rutherford, the author draws up tables of the possible isotopes of many of the elements up to chromium. The atomic mass of the various elements is calculated and found generally to agree well with the accepted experimental values. J. F. S.

The Structure of the Static Atom. IRVING LANGMUIR (*Science*, 1921, **53**, 290—293).—Mathematical. Stability is obtained by the assumption of a repulsive force $Fq=(nh/2\pi)^2\{[(1/m)+(1/M)]/r^3\}$ between an electron of charge e and mass m, and a nucleus of charge Ze and mass M, where n is an integer denoting the quantum state of the electron. The important consequences of Bohr's theory all follow from this one also, and the present theory is much simpler when applied to polyelectronic arrangements. CHEMICAL ABSTRACTS.

The Structure of the Helium Atom. IRVING LANGMUIR (*Physical Rev.*, 1921, **17**, 339—353; cf. A., 1920, ii, 656).—Besides the semi-circular model of the helium atom developed in the paper referred to, the author here develops a double circle model in which the two electrons move in two separate, parallel, circular orbits. This model, however, is unstable, and the ionising potential, computed by applying the quantum theory, is negative. Moreover, the magnetic moment is not zero. The behaviour of the semi-circular model is analysed in greater detail than in the preceding paper. In the case of coupled electrons the quantum theory should be applied, not to the momentum of the individual electrons according to the relation $\int pdq=h/2\pi$, but rather to the momentum which, by being relayed from one electron to another, passes in each direction around the nucleus. CHEMICAL ABSTRACTS.

The Dimensions of Atoms and Molecules. W. L. BRAGG and H. BELL (*Nature*, 1921, **107**, 107).—When estimates are made

from crystal data and from viscosity data of the diameters of the outer electron shell of the inert gases, the results do not show numerical agreement, but the difference between the two estimates is almost constant; that is, the increase in the size of the atom as each successive electron shell is added is nearly the same (except in the case of neon), whether measured by viscosity or by crystal data. It is indicated that (*a*) the elements at the end of any one period in the periodic table are very nearly identical as regards the diameters of their outer electron shells, and (*b*) in passing from one period to the next there is a definite increase in the dimensions of the outer electron shell. Measurements of the infra-red absorption spectra of hydrogen fluoride, hydrogen chloride, and hydrogen bromide lead to the same conclusions. It appears that the forces binding the atoms together are localised at that part of the electron shell where linking takes place. A. A. E.

Molecular Structure and Energy. J. R. PARTINGTON (*Nature*, 1921, **107**, 172).—The models postulated by Lewis and Langmuir, and supported by Rankine's viscosity data, for the molecules of certain halogens, nitrogen, nitrous oxide, nitric oxide, and carbon dioxide, are not in agreement with the specific heats of these gases. A. A. E.

Molecular Structure and Energy. A. O. RANKINE (*Nature*, 1921, **107**, 203; cf. preceding abstract).—A criticism of Partington's views on the apparent discrepancy between Lewis's and Langmuir's models and specific heat measurements. Even if the necessity for revising earlier ideas of energy partition on the basis of the quantum theory is entirely left out of account, it is pointed out that the nitrogen molecule is not spherically symmetrical in the same sense as are the atoms of the inert gases, there being two separate massive nuclei instead of one. Further, it is suggested that the nuclei of all polyatomic molecules may be capable of vibration to and fro. A. A. E.

Isotopes: their Number and Classification. WILLIAM D. HARKINS (*Nature*, 1921, **107**, 202—203; cf. this vol., ii, 445, 582).—The author's theory of nuclear building is supported by the observation that elements of even atomic number consist of more than twice as many isotopes as elements of odd atomic number. In nearly all atoms the number of positive electrons and the number of negative electrons are even, whilst the atomic number is even in 89% of the atoms in the surface of the earth and in 98% of those in meteorites. Most atom nuclei have the formula $(p_2e)_M$, where M is an even number. It is proposed to classify atoms according to their isotopic number, n, which when added to twice the atomic number gives the atomic weight. The value n may be defined as the number of neutrons (pe) which would have to be added to the atom of the same atomic number, but of zero isotopic number, to give the composition of the nucleus. Thus the formula of any nucleus would be $(p_2e)_M(pe)_n$. The isotopic numbers of

elements of even atomic number are mostly even, whilst those of odd atomic number are mostly odd. Graphs showing the relation between the isotopic numbers of elements and their abundance in the earth's crust or in meteorites exhibit well-defined, almost identical, maxima and minima. A. A. E.

Alteration of the Basis of the Atomic Weights and Decennial Revision of the Atomic Weight Table. G. ODDO (*Gazzetta*, 1921, **51**, ii, 161—168).—The history of the controversy concerning the use of the H=1 or the O=16 basis for the calculation of the atomic weights of the elements is outlined, and it is pointed out that the values for the ratio O : H obtained by Stas (15·84—15·88), Keiser (1887), Cooke and Richards, Rayleigh (1889 and 1892), Noyes (1889), Dittmar and Henderson, Morley, Leduc, Thomsen, Berthelot, Keiser (1898), Rayleigh (1904), Guye and Mallet and Noyes (1908) lie between the limits 15·87 and 15·89. Since the value of this ratio is so accurately known, the author suggests that the use of atomic weights referred to the basis O=16 be abandoned. Arguments are also advanced against frequent revision of the atomic weights and the plea made that such revision be effected at ten-year intervals from the present year.

T. H. P.

The New International Commission on Chemical Elements. BOHUSLAV BRAUNER (*Chem. News*, 1921, **123**, 230—232).—The author recommends to the New International Commission that the term " atomic masses " be used only for the whole numbers of the isotopes *B* as determined by the physical (Aston's) method, and that the term " atomic weights " be applied to the numbers obtained by chemical methods, no distinction being made between pure elements, mixtures of isotopes, or single isotopes. He also proposes to call the sub-committee of the " International Commission on Chemical Elements " a " Sub-Committe for Atomic Weights."

W. P. S.

Valency and Co-ordination. SAMUEL HENRY CLIFFORD BRIGGS (T., 1921, **119**, 1876—1879).

Lecture Experiments on the Kinetics of Reactions in Solutions (Applied to the Landolt Reaction). J. EGGERT and B. SCHARNOW (*Ber.*, 1921, **54**, [*B*], 2521—2525).—The authors describe a series of eleven experiments on the reaction expressed by Landolt as the equations : $IO_3'+3SO_3''=I'+3SO_4''$, $IO_3'+5I'+6H^{\cdot}=3I_2+3H_2O$ and $3I_2+3SO_3''+3H_2O=6I'+6H^{\cdot}+3SO_4''$. The results obtained demonstrate the characteristic properties of the kinetics of coupled reactions with reference to the influence of the concentration of the components and to the action of catalysts.

T. H. P.

Inorganic Chemistry.

Preparation of Hydrogen by the Partial Liquefaction of Water-gas. GEORGES CLAUDE (*Compt. rend.*, 1921, **173**, 653—655).—Previous experiments for the preparation from water-gas of hydrogen for use in the synthesis of ammonia had to be abandoned in 1908 owing to difficulties (cf. *ibid.*, 1921, **172**, 974) that have now been overcome by certain simple devices. The water-gas from which a portion of the carbon monoxide has been removed by preliminary cooling is allowed to expand whilst doing external work and lubrication difficulties due to the low temperatures are overcome by the addition of 5% of nitrogen. In this way, it is easily possible, working on a large scale, to obtain a steady supply of hydrogen containing only 1·5% of carbon monoxide. [Cf. *J. Soc. Chem. Ind.*, 1921, 810.] W. G.

Negative Hydrogen Ions. ALFONS KLEMENC (*Zeitsch. Elektrochem.*, 1921, **27**, 470—474).—A theoretical paper in which the difference of energy between the hydrogen atom (H) and that of the negative hydrogen ion (H′) is deduced on the basis of Bohr's atomic model and the assumption that both electrons are in the same orbit. The relationship $H' = H + e + 1/n^2 . 39{\cdot}4$ Cal. is obtained, from which it follows that the process is endothermic in respect of the electron affinity of the halogen atoms. The theoretical value is then calculated, by making use of the thermochemical data of lithium hydride, the specific heats and energy of dissociation of molecular hydrogen, the energy of ionisation of lithium, and Born's lattice energy. The quantity $H' = H + e + 13 \pm 2{\cdot}8$ Cal. is obtained, but for perfect agreement the value $n=2$ must be introduced into the above equation. In view of this, it is stated (with reserve) that both electrons of the hydrogen atoms in lithium hydride must occupy the second Bohr orbit. It is possible that the negative hydrogen ion is formed during the determination of the heat of dissociation of hydrogen by Langmuir's method, but the velocity of the reaction appears to be too small for the energy change, 39·4 Cal. Several equilibrium constants connecting H_2, H, $H^{\cdot}$, and H′ are deduced on the basis of the Nernst equation.

J. F. S.

Magnetochemical Examination of Constitutions in Mineral Chemistry. I. The Sulphur Acids. PAUL PASCAL (*Compt. rend.*, 1921, **173**, 712—714).—The author has determined the molecular magnetic susceptibilities of the inorganic oxygenated sulphur compounds, the hydroxylaminesulphonates, the amidosulphonates, and the organic sulphinic and sulphonic acids, the sulphoxides and sulphones, and from his results has calculated the susceptibilities of the various radicles such as SO_4, SO_3, etc. The results furnish further proof of the constitution of sulphuric and

thiosulphuric acids, of the various thionic acids, and indicate that the sulphurous and sulphinic acids must contain the group SO:.

W. G.

Stability of Persulphates. K. ELBS and P. NEHER (*Chem. Zeit.*, 1921, **45**, 1113—1114).—Sodium, potassium, and ammonium persulphates can be preserved almost unchanged for years if kept dry and protected from sunlight. At ordinary temperatures, aqueous solutions show appreciable decomposition after some days, and with increasing temperature the rate of decomposition rapidly increases and is further accelerated by sunlight. At 100°, decomposition is practically complete in one hour, although the actual velocity varies to a considerable extent with the concentration of the solution, and with the nature of the kation, the sodium salt being somewhat more stable than the potassium and ammonium salts. The addition of sodium sulphate distinctly diminishes the velocity of decomposition, whilst the presence of 5% of sulphuric acid accelerates decomposition five to ten times. As an oxidising agent, sodium persulphate is the most useful salt, and it is often advantageous to diminish the velocity of the reaction, and so prevent loss of available oxygen evolved as gas, by adding about 20% of sodium sulphate (anhydrous) to the solution.

G. F. M.

Effect of Freezing on Colloidal Selenium. A. GUTBIER and F. FLURY [with FR. HEINRICH] (*Kolloid Zeitsch.*, 1921, **29**, 161—172).—A number of experiments on the influence of freezing on selenium sols are described. In the case of sols produced by the action of sulphur dioxide on solutions of selenious acid at 60°, it is shown that the destruction produced by freezing is greater the more completely the solutions have been purified by dialysis. The assertion of Lottermoser, that the factor which influences the precipitation of the colloid is not the amount of the reduction of temperature, but the complete solidification of the solution to an ice-like mass, could not be confirmed (A., 1909, ii, 27), for in the present experiments the solutions were completely frozen, but on melting the greater part of the colloid went back into solution. Sols produced as above, but at ordinary temperatures after freezing, yield on melting the typical selenium sols if they have not been kept frozen too long. If the freezing is repeated many times, or if the sol is kept in the frozen condition too long, the colour by transmitted light becomes less intense and the stability of the sol becomes much less, particularly toward an increase in temperature. It is also shown that the nature of the reducing agent employed in the preparation of the sols and the temperature of preparation have a great influence on the stability toward freezing. Sols prepared by reduction with hydrazine at 60° and dialysed are much more sensitive to freezing than similar sols prepared by reduction with sulphur dioxide at ordinary temperatures. The hydrazine sols coagulated irreversibly on cooling even before solidification occurred and a red deposit was formed on the bottom and top of the frozen mass. In the case of the sulphur dioxide

sols, it is shown that the concentration of the undialysed sol has a marked influence on the stability towards a reduction of temperature. The more concentrated sols are more readily destroyed by freezing than the more dilute solutions, and even in these cases it is found that on keeping the sol in the frozen state for some time an inhomogeneity is produced, and a red ring of precipitated selenium is formed at the top and bottom of the frozen mass.

J. F. S.

Viscosity and Molecular Dimensions of Gaseous Ammonia, Phosphine, and Arsine. A. O. RANKINE and C. J. SMITH (*Phil. Mag.*, 1921, [vi], **42**, 601—614).—The viscosity of ammonia, phosphine, and arsine has been determined by the method previously described (A., 1910, ii, 829) at various temperatures; similarly, measurements have been made with air for comparative purposes. The following values of the viscosity in C.G.S. units $\times 10^{-4}$ and Sutherland's constant, C, are recorded: air, $\eta_0=1\cdot724$, $\eta_{15}=1\cdot799$, $\eta_{100}=2\cdot191$ and $C=117$; ammonia, $\eta_0=(0\cdot943)$, $\eta_{100}=1\cdot303$, $C=(370)$; phosphine, $\eta_0=1\cdot070$, $\eta_{15}=1\cdot129$, $\eta_{100}=1\cdot450$, $C=290$; arsine, $\eta_0=1\cdot470$, $\eta_{15}=1\cdot552$, $\eta_{100}=1\cdot997$, $C=300$. The bracketed values are calculated from the mean of earlier observations of several investigators. By means of Chapman's formula, the area presented by the molecules for mutual collision has been calculated; this is $A=4\pi\sigma^2$ where σ is the radius of the molecule when treated as an attracting elastic sphere. The collision areas in cm.$^2\times 10^{-15}$ are found to be: ammonia, 0·640, phosphine, 0·911, and arsine, 0·985. The values previously given for the gases neon, argon, krypton, and xenon (*loc. cit.*) have been corrected for an error which was associated with the earlier work, and the following corrected values are given: neon, $C=69$, $A=\pi\sigma=0\cdot417$, $\sigma=2\cdot30$; argon, $C=162$, $A=0\cdot648$, $\sigma=2\cdot87$; krypton, $C=212$, $\bar{A}=0\cdot757$, $\sigma=3\cdot10$, and xenon, $C=283$, $\bar{A}=0\cdot915$, and $\sigma=3\cdot41$. J. F. S.

The Electronic Synthesis of Chemical Compounds. I. Formation of Ammonia. EGON HIEDEMANN (*Chem. Zeit.*, 1921, **45**, 1073).—By passing a mixture of pure hydrogen and nitrogen through an electron tube, maintaining a tension a few volts above the ionisation tension of both gases, a relatively high yield of ammonia was obtained. A parallel is drawn between photochemistry and electron chemistry, in which light and electrons are the respective activating agents. E. H. R.

Reaction of Nitrous Acid with Hydrazine and with Azoimide. E. OLIVERI-MANDALÀ (*Gazzetta*, 1921, **51**, ii, 201—207; cf. this vol., ii, 346).—The method given for the estimation of nitrous acid by Dey and Sen-Gupta (A., 1911, ii, 822; 1912, ii, 296), who find that a nitrite loses two-thirds of its nitrogen in the elementary state when treated with hydrazine sulphate, is not exact, since the decomposition of hydrazine nitrite in this way is accompanied by secondary reactions varying markedly with variation in the experimental conditions. Highly discordant results have, indeed,

been obtained by different authors who have investigated the decomposition of hydrazine nitrite (Girard and Saporta, A., 1904, ii, 678; Francke, A., 1906, ii, 82; Angeli, A., 1894, ii, 93; Curtius, A., 1893, ii, 372; Dennstedt and Göhlich, A., 1898, ii, 425; Sommer, A., 1913, ii, 952; Sommer and Pincas, A., 1916, ii, 316), and many different interpretations of the reaction have been advanced.

The author's experiments on the interaction of equivalent solutions of potassium nitrite and hydrazine sulphate in an atmosphere of carbon dioxide give the same result at the ordinary temperature as at the boiling point of the solution, the mixed gases evolved consisting of about 10·2—11·7% by vol. of nitrogen and 88·3—89·8% of nitrous oxide; this result is not in agreement with Girard and Saporta's equation (*loc. cit.*). When the proportion of nitrous acid taken is increased, the percentage of nitrogen present in the gases evolved at the boiling point of the liquid increases and, when $N_2H_4 : HNO_2 = 2 : 3$, $1 : 2$, and $2 : 5$, amounts to 41·8, 48·6, and 49·1 respectively. As regards the decomposition in presence of sulphuric acid, a solution containing 0·334, 0·334, and 0·334 gram-mol. per litre of hydrazine, nitrous acid, and sulphuric acid yields a mixture of 80% by volume of nitrous oxide and 20% of nitrogen, whilst with 0·334, 0·668, and 0·334 gram-mol., the percentages of the two gases are 68·1 and 30·9 respectively. These results show that the reaction between hydrazine and a nitrite cannot be used for estimating the latter, the nature of the gases liberated as well as their proportions varying with the conditions.

The author has also studied the action of hydrazine hydrate on free nitrous acid under diverse conditions, but in no case was it found possible to detect the formation of hyponitrous acid.

To the two principal reactions given by Sommer and Pincas (*loc. cit.*), it seems probable that there should be added that expressed by the equation $N_2H_4 + 2HNO_2 = N_2 + N_2O + 3H_2O$.

T. H. P.

Oxidation and Luminescence of Phosphorus. III. Catalytic Action of Vapours. HARRY B. WEISER and ALLEN GARRISON (*J. Physical Chem.*, 1921, **25**, 473—490; cf. this vol., ii, 248, 637).—The vapours of a number of organic compounds influence the rate of oxidation of phosphorus. Most of the vapours examined retard the oxidation, but nitrobenzene and diphenylamine accelerate it. Phosphorous oxide is an intermediate product in the oxidation of phosphorus to phosphoric oxide. The rapid oxidation of phosphorus to phosphorous oxide occurs at 27° in pure oxygen under 1 atm. pressure, whilst that of phosphorous oxide to phosphoric oxide under the same conditions occurs at 65°. As a rule, the heat of reaction of the first step raises the temperature in the reaction zone to the point where the lower oxide oxidises with sufficient velocity to emit light. In a stream of oxygen at temperatures below 27°, the small amount of phosphorus which vaporises is oxidised to phosphorous oxide, and this is slowly converted into phosphoric oxide without the emission of

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light. In a stream of gas or vapour containing oxygen, the chief oxidation product is phosphorous oxide if the temperature is low, if the concentration of oxygen in the reaction zone is low, or if the vapours condense on the surface of the phosphorous oxide particles. The ions formed during the oxidation of phosphorus consist of oxide particles about charged nuclei and vapours are adsorbed or condensed both on the charged and uncharged particles. Condensed vapours decrease the conductivity of "phosphorised" air by weighting down the charged particles. If the adsorbed vapours react with phosphorous oxide they increase the velocity of oxidation of phosphorus both by removing oxide particles from the zone of reaction and by raising the temperature. Nitrobenzene and diphenylamine act in this way. If the adsorbed vapours are inert they prevent further oxidation of phosphorous oxide and also form a cloud near the surface of the phosphorus which retards the action. If two vapours are adsorbed to the same extent, the heavier one will form the denser cloud and will have the greater inhibiting action. It is concluded that vapours (with the exception of a trace of water vapour) which influence the rate of oxidation of phosphorus are not catalysts in the ordinary sense of the word. The vapours are merely condensed on the charged or uncharged products, and act as described above. The cloud surrounding the phosphorus approaches nearer the surface as the oxidation becomes less energetic, and may form a protecting film which reduces vaporisation and oxidation of the phosphorus to a minimum.

J. F. S.

Fusion of Carbon. EUGEN RYSCHKEWITSCH (*Zeitsch. Elektrochem.*, 1921, **27**, 445—452; cf. this vol., ii, 258, 586).—A description of further experiments on the fusion of carbon. It is shown that carbon can be melted under ordinary pressure by an electric current. The carbon always melts at the point where the current and consequently the temperature is the highest. Under suitable conditions, high current efficiency, and good heat insulation, carbon may be melted by comparatively small currents The solidified drops of carbon and the two points from which the drop has fallen consist of pure graphite. The sublimation point of carbon at ordinary pressures lies very near to the melting point, and in consequence the failures to melt carbon described in the literature are to be attributed to the superposition of the sublimation over the melting. In saturated carbon vapour, unusually large and well-formed graphite crystals are produced, which grow in the planes of stronger affinity. The completely closed furnaces used in the melting of carbon have made a determination of the melting point impossible up to the present. J. F. S.

Viscosities and Molecular Dimensions of Methane, Hydrogen Sulphide, and Cyanogen. A. O. RANKINE and C. J. SMITH (*Phil. Mag.*, 1921, [vi], **42**, 615—620; cf. this vol., ii, 694).—The viscosities of methane, hydrogen sulphide, and cyanogen have been measured at 17° and 100°, and from the results the values of the Sutherland constant (C) and the collision area in $cm^2 \times 10^{-15}$

($\bar{A}$) have been calculated. The following values are recorded: methane, $\eta_0=1\cdot035$, $\eta_{17}=1\cdot094$, $\eta_{100}=1\cdot363$, $C=198$, and $\bar{A}=\cdot0772$; hydrogen sulphide, $\eta_0=1\cdot175$, $\eta_{17}=1\cdot251$, $\eta_{100}=1\cdot610$, $C=331$, and $\bar{A}=0\cdot773$; cyanogen, $\eta_0=0\cdot935$, $\eta_{17}=0\cdot995$, $\eta_{100}=1\cdot281$, $C=330$, and $\bar{A}=1\cdot21$. The viscosity values are given in C.G.S. units $\times 10^{-4}$.

J. F. S.

Helium-bearing Natural Gas. G. SHERBURNE ROGERS (*U.S. Geol. Survey, Prof. Paper*, 1921, No. 121, 113 pp.).—A résumé of the chemistry of helium and the radioactive elements, and a detailed account of the distribution, chemical composition, and chief sources of helium-bearing natural gas. Helium constitutes from 0·5 to 2% of certain nitrogen-rich natural gases occurring in Kansas, whilst natural gas occurring in Europe contains a maximum of only 0·38% helium. [See *J. Soc. Chem. Ind.*, 1921, Dec.]

J. S. G. T.

Some Properties of Fused Sodium Hydroxide. THOMAS WALLACE and ALEXANDER FLECK (T., 1921, **119**, 1839—1860).

Conversion of Ammonium Sulphide and of Thiosulphates into Sulphates. W. GLUUD (*Ber.*, 1921, **54**, [*B*], 2425—2426).—At 100°, ammonium sulphide in aqueous solution may be readily and completely converted into ammonium sulphate by air under a pressure of 10 atmospheres. Under similar conditions, sodium thiosulphate undergoes total transformation into sulphate, provided that sufficient alkali is present to unite with the sulphuric acid formed from the sulphur; if such excess of alkali is lacking, part of the sulphur separates in the elementary condition. A lower pressure than that mentioned above may be used, but in such case either the temperature must be raised or the duration of the action increased.

T. H. P.

The Melting and Boiling Points of Ammonium Sulphate. ERNST JÄNECKE (*Zeitsch. angew. Chem.*, 1921, **34**, 542—543; cf. A., 1920, ii, 757).—The equilibrium between ammonia, ammonium sulphate, ammonium hydrogen sulphate, sulphuric acid, and water has been further investigated and the results are shown graphically. Ammonium sulphate when heated evolves more ammonia than water, so that a certain amount of ammonium hydrogen sulphate (m. p. 147°) is first formed, and later this loses water, giving the pyrosulphate. The equilibrium diagram is also augmented by the inclusion of an acid sulphate, $NH_4{\cdot}H_3(SO_4)_2$ (m. p. 48°), and an ammonia compound $(NH_4)_2SO_4,2NH_3$. There are eutectics between sulphuric acid and the acid sulphate (m. p. −20°), between the acid sulphate and the hydrogen sulphate (m. p. 39°), and between the latter and the pyrosulphate (m. p. 138°).

A. R. P.

The Graphitic Nature of the Carbon of Nitro-lime. NAOTO KAMEYAMA (*J. Chem. Ind. Japan*, 1921, **24**, 1131—1142).—It is found that the carbon which separates when nitro-lime is treated with concentrated hydrochloric acid and 55% hydrofluoric acid is

entirely graphitic. This was proved by the specific gravity (2·246), the heat of combustion (7,857 cal. per gram), the diffraction rings formed by *X*-rays, the electrical conductivity and by oxidation to graphitic acid, satisfactory coincidence being obtained in parallel experiments with Acheson graphite. K. K.

The Octahydrate of Magnesium Sulphate. SHIRÔ TAKEGAMI (*J. Chem. Soc. Japan*, 1921, **42**, 441—453; cf. this vol., ii, 30).—The equilibrium systems of magnesium sulphate, sodium sulphate, and water at 25° and 30° were studied, and the existence of the octahydrate of magnesium sulphate was proved. (From these results it is deduced that in the equilibria of the reciprocal salt pairs, sodium chloride and magnesium sulphate and sodium sulphate and magnesium chloride at 25° there are ten solid phases, not nine as previously stated (*loc. cit.*), the phase $MgSO_4,8H_2O$ having to be added although its numerical values are still lacking.) The solid phase (der Bodenkörper) of the system at 25° is always the octahydrate. At 30°, also when the solution contains less than 32% of sodium sulphate, the solid phase is the octahydrate, which, however, is replaced by the heptahydrate when the concentration of the sodium sulphate exceeds 32%. When the solution contains about 7—9% of sodium sulphate, the solid phase below 45·5° is the octahydrate, whilst between 46·1° and 77·2° it is the heptahydrate. From the transition point in the presence of sodium sulphate, the following points are deduced for the case of magnesium sulphate alone:

$$\text{Octahydrate} \underset{\longleftarrow}{\xrightarrow{48{\cdot}2^\circ}} \text{heptahydrate} \underset{\longleftarrow}{\xrightarrow{\text{above } 77{\cdot}2}} \text{hexahydrate.}$$ K. K.

The Atomic Volume of Isotopes. FREDERICK SODDY (*Nature*, 1921, **107**, 41—42).—Values obtained for the density and atomic weight of ordinary lead, lead from thorite, and lead from uranium minerals have been compared. It is concluded that the atomic volumes cannot differ by so much as three parts in ten thousand and the atomic diameters by so much as one part in ten thousand. A. A. E.

The Purification of Mercury. C. HARRIES [and FRITZ EVERS] (*Zeitsch. angew. Chem.*, 1921, **34**, 541—542).—In order to test the value of the method described previously (this vol., ii, 552) for the purification of mercury, comparative tests on a 1% lead amalgam were carried out. One portion was allowed to fall twice through a long column of nitric acid (*d* 1·175); the resulting product contained no trace of lead, but the loss of mercury was 3·7%. A second portion was heated for ten hours at 150—160° while passing a current of air through it; the resultant metal was left for several hours in contact with strong hydrochloric acid, and, after thorough washing with water, was found to be free from lead. The loss of mercury in the latter case was only 2%. An amalgam containing 1% of tin after three passages through nitric acid lost 9·2% of its mercury content and the remaining metal still contained traces of tin. Treated by the hot air method, it

lost only 1·4% of mercury in fifteen hours, but the residual metal contained some tin. A second test showed that if the air used is first passed through fuming hydrochloric acid all the tin is removed in twelve hours. A. R. P.

Critical Constants of Mercury. SOPHUS WEBER (*Onnes Comm. Leiden Suppl.*, 1920, 21—31; from *Chem. Zentr.*, 1921, iii, 769—770).—Observation on the critical temperature of mercury showed that it is higher than formerly supposed and probably exceeds 1700° Abs. From a consideration of the data of Bender on the densities of liquid and vaporous mercury, the author shows that the critical temperature must be about 1450+273° Abs. On this assumption, the critical density, d_c, is 5·0 and the critical pressure, p_c, about 1042 atmospheres, which values are in good agreement with those obtained by extrapolation by Knudsen's formula. Plotting d/d_c against T/T_c, and log p_c/p against $(T_c/T-1)$, mercury is shown to fall into line with other monatomic gases. G. W. R.

Double Nitrate of Aluminium and Potassium. N. M. LAPORTE (U.S. Pat. 1377081).—A double nitrate of aluminium and potassium of the formula $Al(NO_3)_3,3KNO_3,10H_2O$ is prepared by crystallisation from a solution of potassium nitrate and aluminium nitrate in nitric acid. The proportions of the potassium nitrate and aluminium nitrate may be somewhat varied. CHEMICAL ABSTRACTS.

Graphitisation in Iron–Carbon Alloys. KÔTARÔ HONDA and TAKEJIRÔ MURAKAMI (*Sci. Rep. Tohoku Imp. Univ.*, 1921, **10**, 273—303).—Graphitisation occurs in iron–carbon alloys as a decomposition of cementite and not as a separation of graphite in the molten state. The decomposition is effected catalytically by carbon monoxide or dioxide according to the equations $2CO=CO_2+C$ and $CO_2+Fe_3C=2CO+3Fe$. The process continues until the concentration of the gas in the alloy is reduced below a certain amount or until the temperature falls below the graphitising range. Any treatment of the alloy tending to eliminate carbon dioxide or monoxide present, such as heating above 1400°, will also prevent graphitisation. The formation of flaky graphite is explained by the aggregation of graphite particles as they separate from cementite by reason of interfacial tension. A phase diagram of the system iron–carbon is given embodying the authors' theories. G. W. R.

The Preparation of Nickel Carbonyl. E. TASSILLY, H. PÉNAU, and E. ROUX (*Bull. Soc. chim.*, 1921, [iv], **29**, 862—864).—In the preparation of nickel carbonyl by passing carbon monoxide over reduced nickel the optimum temperature is 45° at a pressure of 3 cm. Within reasonable limits, the yield of carbonyl from carbon monoxide was independent of the rate of flow of the gas, provided that the velocity was not so great as to prevent condensation by suitable cooling. The coefficient of utilisation was 84% for the metal and 37% for the gas. W. G.

Physico-chemical Analysis of Zirconium Oxychlorides and Zirconium Oxide Sols. MONA ADOLF and WOLFGANG PAULI (*Kolloid Zeitsch.*, 1921, **29**, 173—184; cf. A., 1917, ii, 563).—The complex ionisation of zirconium oxychloride has been examined from experimental data on the hydrogen- and chlorine-ion concentrations, the total zirconium and chlorine concentrations of the solution, the electrical conductivity at 25°, the depression of the freezing point, and the electric migration. The solutions used were made in cold water and kept for ten days before use. The ionisation occurs according to the scheme (i) $ZrAn_4+4H_2O \rightleftarrows Zr(OH)_4+4HAn$, (ii) $2ZrAn_4 \rightleftarrows ZrAn_4,ZrAn_2^{\cdot\cdot}+2An'$, (iii) $2ZrAn_4 \rightleftarrows ZrAn_6''+ZrAn_2^{\cdot\cdot}$(An—an univalent anion). The results show that the ratio between the zirconium hydroxide formed and the unhydrolysed oxychloride is simple and can be expressed in different concentrations by the figures 1 : 1, 3 : 4, 2 : 3, and 1 : 2. A comparison of the hydrolysis with a normal hydrolysis shows that an astonishingly large amount of zirconium hydroxide is formed and a very high degree of hydrolysis is attained. The hydrolysis is not only abnormal in respect of its high value, but also in its connexion with the concentration of the hydrochloric acid. It does not increase with successive dilution, but fluctuates irregularly. It fluctuates between 35% and 49% for a dilution of 500 times. This behaviour is attributed to the formation of complexes, of the type $x Zr(OH)_4,y ZrOCl_2$, which react with the hydrochloric acid and form highly complex acids of the types $Zr(OH)_4Cl_2H_2$ and $Zr(OH)_2Cl_4H_2$. Curves representing the change in concentration of the hydrogen and chlorine ions respectively present an unique phenomenon, inasmuch as they intersect three times with changing concentration. The points of intersection lie approximately at $N/100$, $N/8$, and $3N/8$. Transport measurements show that the nature of the ion containing zirconium changes in the regions between the intersections of the curves. Tables of the complexes present and the ions to which they give rise are included in the paper. Zirconium oxide sols, produced by the dialysis of solutions of the oxychloride, have been examined. The sols are coagulated by electrolytes only in concentrated solutions ($N/4$ and above). Two of the sols have been investigated and shown to have the composition (*a*) $5Zr(OH)_4,ZrOCl_2$, and (*b*), $7Zr(OH)_4,ZrOCl_2$.

J. F. S.

Mineralogical Chemistry.

Crystal Structure of Alabandite (MnS). RALPH W. G. WYCKOFF (*Amer. J. Sci.*, 1921, [v], **2**, 239—249).—The various possible space-groups suggested by the measurements of the *X*-ray reflections from a cube-face and also from the powdered mineral are discussed. The arrangement of the atoms (with either four

or thirty-two chemical molecules to the unit cell) is either that of the "rock-salt type" or a grouping (tetrahedral or tetartohedral) very close to this. L. J. S.

Dolomite from Binn, Switzerland. PAUL KOLLER (*Jahrb. Min.*, 1918, *Beil.-Bd.* **42**, 457—498).—A detailed crystallographic description is given of the colourless water-clear crystals from the saccharoidal dolomite-rock. Crystals of another type from the same occurrence are transparent with a pale yellowish tinge; these have refractive indices $\omega=1\cdot6799$, $\epsilon=1\cdot5013$ (Na), and gave analyses I and II by P. POOTH.

	$CaCO_3$.	$MgCO_3$.	$FeCO_3$.	Sp. gr.
I	53·38	46·45	0·13	2·882
II	53·19	46·52	0·09	—
III	52·35	46·02	1·79	2·887

Both these analyses show a slight excess of magnesia over that required by normal dolomite, I corresponding to $32CaCO_3,33MgCO_3$ and II to $26CaCO_3,27MgCO_3$. Corresponding with the low percentage of iron, the refractive indices are lower than any previously determined for dolomite. Analysis III is of dolomite from Scaleglia, Disentis, corresponding with $FeCO_3,36CaCO_3,37MgCO_3$. Etching experiments were made on cleavage flakes with sulphuric, nitric, hydrochloric, acetic, and formic acids, each of which produces different forms of etch-figures. Different forms of etch-figures are also produced by the same acid when of different concentrations. The material of analyses I and II yielded the same type of etch-figures, but the more ferruginous dolomite is rather more readily attacked. L. J. S.

Lazulite from Graves Mountain, Georgia. THOMAS L. WATSON (*J. Washington Acad Sci.*, 1921, **11**, 386—391).—Analysis, by J. W. WATSON, of material from this well-known locality for lazulite gave:

P_2O_5.	Al_2O_3.	FeO.	MgO.	CaO.	H_2O.	SiO_2.	Total.	Sp. gr.
38·25	33·92	3·99	9·08	3·12	5·83	6·05	100·24	2·958

Deducting silica as quartz, this gives the usual formula $(Fe,Mg,Ca)O,Al_2O_3,P_2O_5,H_2O$. The calcium is, however, higher than previously recorded for the mineral, and this variety is therefore distinguished as calcium lazulite. Other occurrences of lazulite in the United States are noted. L. J. S.

Cornetite from Bwana Mkubwa, Northern Rhodesia. A. HUTCHINSON and A. M. MACGREGOR (*Min. Mag*, 1921, **19**, 225—232).—The mineral occurs as a thin, crystalline crust of a fine peacock-blue colour on sandstone and shale. The minute crystals are orthorhombic with the forms *m*(110), *d*(102), *v*(221); $a:b:c=0\cdot9855:1:0\cdot7591$. Optic axial plane (001), acute negative bisectrix perpendicular to (100). *d* 4·10, H 4—5. Analysis gave:

CuO.	Fe_2O_3.	P_2O_5.	H_2O.*	Insol.	Total.
67·28	0·53	18·83	8·24	4·03	98·91

* Loss at 190°, 0·18; loss on ignition 8·77%.

This gives the formula $2Cu_3(PO_4)_2,7Cu(OH)_2$ or perhaps $Cu_3(PO_4)_2,3Cu(OH)_2$. The mineral agrees in its crystallographic and optical characters with cornetite from Katanga (A., 1920, ii, 441) and differs only in not containing cobalt replacing copper.

L. J. S.

Jurupaite, a New Mineral. ARTHUR S. EAKLE (*Amer. Min.*, 1921, 6, 107—109).—This is another of the several hydrated calcium silicates described from the metamorphic limestone at Crestmore, California (A., 1919, ii, 113). It resembles pectolite in appearance, and occurs in the blue calcite as compact spheres of soft, silky, radiating fibres. The oblique optical extinction suggests monoclinic symmetry. The mineral fuses readily to a clear white glass, and is easily soluble in dilute hydrochloric acid without gelatinisation. It gives no colour with phenolphthalein. The mean of two analyses is:

SiO_2.	CaO.	MgO.	H_2O.	Total.	Sp. gr.
48·87	38·66	4·19	7·89	99·61	2·75

This gives the ratios $2(Ca,Mg)O,2SiO_2,H_2O$. The loss of water at 120° is less than 1% and all is not expelled over the bunsen flame. The formula is therefore written $H_2(Ca,Mg)_2Si_2O_7$, being like crestmoreite and riversideite a derivative of orthosilicic acid. Plazolite (A., 1921, ii, 270) from this locality shows several points of similarity to calcium-garnet. L. J. S.

The Cerium Minerals of Bastnäs, Sweden. PER GEIJER (*Sveriges Geol. Undersökning*, 1921, *Årbok*, **14** (for 1920), No. 6, 1—24).—Cerite, the mineral in which cerium was discovered, is known only from this locality. A detailed description is given of the môde of occurrence of the cerium ore. Examined in thin sections under the microscope, it is seen to consist of a fine grained aggregate of the cerium minerals cerite, bastnäsite, törnebohmite, orthite, fluocerite, and lanthanite, the optical characters of each of which are given. A new estimation of water in the orthite (*d* 4·20) gave 1·52. Introducing this value in Cleve's analysis (1863) the ratios $H_2O:RO:R_2O_3:SiO_2$ become 1 : 4·29 : 2·61 : 5·93, which is a closer approach to the epidote formula. The new mineral *törnebohmite* was detected in the micro-sections as pale green grains (*d* 4·94) differing in optical characters from the associated cerite. Analysis by R. MAUZELIUS gave (also chalcopyrite 0·96, molybdenite not det., insoluble 0·95):

SiO_2.	Ce_2O_3.	$(La,Di)_2O_3$.	Al_2O_3.	FeO.	MnO.	MgO.	CaO.	F.	Ign.	Total.
22·05	27·52	34·85	8·55	1·91	0·05	0·49	0·23	0·29	1·70	99·55

Calculating RO as R_2O_3, these results give a formula, $R_2(ROH)(SiO_4)_2$, analogous to those of andalusite and topaz. The mineral is, however, more closely allied to cerite, from which it differs chemically in containing more aluminium and less calcium. L. J. S.

Monticellite Crystals from a Steel-works Mixer Slag. A. F. HALLIMOND, with analysis by J. H. WHITELEY (*Min. Mag.*, 1921, **19**, 193—195).—The pale-brown, transparent crystals are

orthorhombic with the forms $b(010)$, $m(110)$, and $k(021)$; $a:b:c=0{\cdot}4382:1:0{\cdot}5779$. The optic axial plane is parallel to (001) and the acute negative bisectrix perpendicular to (010); α 1·663, β 1·674, γ 1·680; $2V$ 74½°, d 3·20. Analysis shows the presence of 16·5 mol.% of true olivine in solid solution with the monticellite $Ca(Mg,Fe,Mn)SiO_4$, which is in accord with the variation in the physical characters from those of pure monticellite.

SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	P_2O_5.	CaS.	Total.
34·80	0·24	0·27	trace	4·11	13·39	17·65	28·45	0·905	0·055	99·87

L. J. S.

Chemical Constitution of Zeolites. G. TSCHERMAK (*Sitzungsber. Akad. Wiss. Wien*, 1917, **126**, 541—606, 1918, **127**, 177—289; from *Jahrb. Min.*, 1921, ii, Ref. 150—153).—Twenty-one new analyses are given of various zeolites. In all cases the ratio $Al:Ca(Sr,Ba)+Na_2(K_2)$ is 2 : 1. Omitting oxygen, all zeolites may be represented by the formulæ $Si_xAl_2CaH_{2y}$ and $Si_zAl_2Na_2H_{2v}$, where x and z range from 2 to 10, and y and v from 2 to 9. Or again, neglecting hydrogen, they all contain a group $Si_2Al_2CaO_8$ or $Si_2Al_2Na_2O_8$. This group is regarded as a nucleus ("Kern") and represented as *Kc* or *Kn* respectively (also *Kb* and *Ks* for the corresponding barium and strontium nuclei). The various zeolites are regarded as compounds of one or other of these nuclei with a silicic acid, combined water, and water of crystallisation. The silicic acid and water of hydration are supposed to form a network enclosing the nuclei. Such a structure is regarded as offering an explanation of the variation of the optical characters of the zeolites with loss or gain of water, the various adsorption phenomena, and the ease with which the bases may be replaced. The following is a summary of the different groups:

A. Orthosilicates in combination with SiH_4 and H_2O: Natrolite, $SiH_4Kn=Si_3Al_2Na_2H_4O_{12}$. Scolecite, $SiH_4KcOH_2=Si_3Al_2CaH_6O_{13}$. Mesolite, a double salt of these two in the ratio 1 : 2. Edingtonite, $SiH_4KbOH_2,aq=Si_3Al_2BaH_8O_{14}$. Gismondine, $H_2OKcO_2H_4,aq=Si_2Al_2CaH_8O_{12}$, also with SiH_4 in place of H_2O. Laumontite, $SiH_4KcSiH_2=Si_4Al_2CaH_8O_{16}$. Thomsonite, a double salt of the compounds H_2OKnOH_2,aq and H_2OKcOH_2 in the ratio 1 : 3; also in the latter SiH_4 in place of H_2O.

B. Disilicates combined with polysilicic acids and H_2O: Analcite, $Si_2H_4Kn=Si_4Al_2Na_2H_4O_{12}$, also with Si_4H_8, Si_4H_4, or H_2O in place of Si_2H_4. Faujasite, $Si_4H_8KcO_2H_4,4aq$, also with Si_2H_4. Chabazite, $Si_2H_4KcO_2H_4,2aq=Si_4Al_2CaH_{12}O_{18}$, also with Si_4H_8, Si_2H_2, or SiH_4. Gmelinite with *Kn* in place of *Kc*. Levynite like chabazite with Si_2H_2 and SiH_2. Stilbite, $Si_4H_8KcOH_2,2aq=Si_6Al_2CaH_{14}O_{23}$, also with Si_6H_{12}, Si_4H_4, or Si_2H_4. Harmotome with *Kb* instead of *Kc*. Phillipsite like stilbite but with Si_2H_4, Si_2H_2, SiH_4, SiH_2. Heulandite, $Si_4H_4KcO_2H_4,aq=Si_6Al_2CaH_{10}O_{21}$, also with Si_6H_6, Si_4H_8, or Si_2H_4. Brewsterite with *Ks* in place of *Kc*. Mordenite like heulandite with Si_3H_8. L. J. S.

Ferroanthophyllite from Idaho. EARL V. SHANNON (*Proc U.S. Nat. Museum*, 1921, **59**, 397—401).—A greyish-green, asbesti-

form mineral intergrown with galena occurs in the Tamarack-Custer mine near Gem in the Coeur d'Alene district. It is orthorhombic with optically positive elongation, $\alpha=1{\cdot}668$, $\gamma=1{\cdot}685$; *d* 3·24. It is insoluble in acids, and fuses to a black, magnetic glass. Analysis gave:

SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	CaO.	MgO.	$H_2O(<110°)$.	$H_2O(>110°)$.	Total.
49·30	1·30	2·15	30·50	3·48	10·73	0·66	0·18	2·13	100·43

Deducting ferric oxide and alumina as gedrite (RO,R_2O_3,SiO_2), this gives the metasilicate formula $(Fe,Ca,H_2,Mn)O,SiO_2$, but only when the water, which is expelled at a high temperature, is taken into account. Being the iron end-member of the anthophyllite series the name ferroanthophyllite is applied [cf. iron-anthophyllite, A., 1919, ii, 165]; similarly, the magnesium end-member of this series may be called magnesioanthophyllite. L. J. S.

A New Type of Mineral Water: Nitrated Waters. CHARLES LEPIERRE (*Compt. rend.*, 1921, **173**, 783—786).—A mineral water found at Ericeira in Portugal, obtained from a well 15 metres deep and 50 metres from the sea, contained 0·686 gram of nitrates, expressed as sodium and calcium nitrates, per litre, equivalent to 18·8% of the total mineral salts. Their origins are considered to be due to biochemical and hydrological phenomena. W. G.

Analytical Chemistry.

Apparatus for Technical Gas Analysis. G. ANDOYER (*Ann. Chim. anal.*, 1921, **3**, 293—294).—The apparatus consists of a measuring burette provided with a water-jacket; the bottom of the burette is connected with a levelling reservoir, whilst the top is fitted with a three-way tap. The absorption pipettes are connected, in turn, with the stem of the tap and thence with the burette; the other branch of the three-way tap carries a small funnel by which water may be introduced for washing out reagents. W. P. S.

Atmospheric Corrections for the Harcourt Standard Pentane Lamp. E. B. ROSA, E. C. CRITTENDEN, and A. H. TAYLOR (*J. Opt. Soc. Amer.*, 1921, **5**, [v], 444—452).—A review of results obtained for the factor correcting the candle-power of the Harcourt 10-candle pentane lamp for variations of humidity of the atmosphere. The mean correcting factor determined at the National Physical Laboratory is 0·645, whilst the result obtained at the Bureau of Standards is 0·567, the factor in each case representing the percentage decrease in candle-power due to an increase of 1 litre of water vapour per cub. metre of air. The discrepancy in the two values is traced to a difference of atmospheric temperature in the two cases, and it is shown that the experimental values are

brought into agreement by using two factors, namely, a factor 0·52% decrease in candle-power per litre of water vapour per cub. metre of air (in the absence of any temperature difference) and a factor 0·08% decrease per degree rise of temperature. The factor 0·52% agrees with the recently determined value found at the Bureau of Standards and is in agreement with results obtained recently by Takatsu and Tanaka in Japan. It is suggested that 15° should be taken as the normal atmospheric temperature for calculation of the candle-power of the lamp. J. S. G. T.

Device for Filling Burettes. G. BRUHNS (*Chem. Zeit.*, 1921, **45**, 1004).—The lower end of a burette, without a tap, is connected with a short vertical length of glass tube carrying a side tube; this side tube is bent downwards and provided with a jet and spring clip. The end of the vertical tube is connected by a rubber tube with a piece of glass tube which reaches to the bottom of the reservoir containing the reagent solution. The burette is filled by opening a spring clip on the latter piece of rubber tube and applying suction to the top of the burette. W. P. S.

Colorimetric Method of Estimating Hydrogen-ion Concentration. Some Applications in the Analytical Laboratory. NORMAN EVERS (*Analyst*, 1921, **46**, 393—400).—The colorimetric method is described in detail;, the method depends on the fact that with different indicators the colour change extends over a characteristic zone of hydrogen-ion concentration. The method may be used with clear or turbid liquids free from colour, for coloured liquids, and is useful for ascertaining the reaction of such substances as sodium salicylate, morphine hydrochloride, calcium chloride, potassium iodide, etc. W. P. S.

Methyl-orange as an Indicator in the Presence of Indigo Carmine. FRANK X. MOERK (*Amer. J. Pharm.*, 1921, **93**, 675—679; cf. A., 1907, ii, 910).—The sensitiveness of methyl-orange, particularly in slightly coloured solutions, may be increased by the addition of indigo-carmine; 1 gram of methyl-orange and 2 to 4 grams of indigo-carmine per litre of water is a suitable concentration for the indicator solution. W. P. S.

A Simple Method for the Preparation of Sodium Hydroxide Solution free from Carbonate. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 1413—1417).—Commercial sodium hydroxide is dissolved in water to form an approximately normal solution. To each litre 50 c.c. of milk of lime is added; after well shaking, the solid is allowed to settle and the caustic solution decanted off with the usual precautions. The solution is titrated and diluted to 0·1*N*; it is quite free from carbonate, and contains only 1—2 mg. of calcium per litre, which has no influence in analytical determinations. S. I. L.

Direct Estimation of Water in Mixed Sulphuric and Nitric Acids. E. BERL and W. VON BOLTENSTERN (*Zeitsch. angew. Chem.*, 1921, **34**, 526—528).—A calorimeter for determining the heat of dilution of the sample consists of a vacuum-lined vessel

40 mm. in diameter and 300 mm. high. It is fitted with an agitator consisting of two blades of sheet glass or aluminium connected together and worked by two rods, and with a thermometer graduated to 1/10 of a degree. Two hundred c.c. of distilled water are placed in the calorimeter, 20 c.c. of mixed acid added through a fine glass tube dipping below the surface of the water, and the corrected rise of temperature obtained as with the Mehler bomb calorimeter. The water content of the acid is read off from a curve prepared by a series of tests of different dilutions of an acid of known composition. Different ratios between the two acids correspond with different curves. An increase of 1% in the N_2O_3 content of the acid was also found to give a water figure 1% too high. Organic matter is without effect, and for varying dilutions of a mixture of constant composition determinations can be rapidly made to an accuracy of 0·05—0·06% H_2O. C. I.

A New Process for the Estimation of Fluorine in the Cold. TRAVERS (*Compt. rend.*, 1921, **173**, 836—838).—The fluorine is first converted by suitable means into alkali fluoride. To the fluoride solution, generally alkaline, a known amount of silica, as potassium silicate, is added. Usually twice the theoretical amount of silica required to convert the fluorine to potassium silicofluoride is sufficient. The liquid is then neutralised with hydrochloric acid, using methyl-orange as an indicator, and an excess of acid, about 2 c.c., is added. Solid potassium chloride is added until the solution contains 20% of it. The precipitate is filtered off, washed free from acid with 20% potassium chloride and titrated with *N*/5-potassium hydroxide as previously described in the estimation of silica (this vol., ii, 710). One c.c. of *N*/5-potassium hydroxide is equivalent to 0·0057 gram of fluorine. W. G.

Estimation of Small Quantities of Fluorine in Natural Products by Means of Hempel and Scheffler's Gasometric Method. H. SEETZ (*Zeitsch. anal. Chem.*, 1921, **60**, 321—330).—The method described by Hempel and Scheffler (A., 1899, ii, 380) is suitable for the estimation of the small quantities of fluorine occurring in certain vegetable substances; when the ash of the latter contains much carbonate or chloride, a preliminary treatment with 10% acetic acid is recommended. W. P. S.

Some Notes on the Estimation of Sulphur and Chlorine by the Lamp Method. S. BOWMAN (*J. Inst. Petroleum Tech.*, 1921, **7**, 334—338).—In estimating sulphur in petroleum products by this method a certain amount of sulphur is always absorbed by the wick. A method of eliminating this source of error is described. [See further *J. Soc. Chem. Ind.*, 1921, Dec.] L. A. C.

Estimation of Sulphate-, Chloride-, and Carbonate-ions in Soda-Lime-Glass. MASAO IKAWA (*J. Chem. Soc. Japan*), 1921, **42**, 768—785).—The sulphate and chloride radicles are precipitated as barium sulphate and silver chloride respectively, from the clear solution, obtained by warming on a water-bath the finely-powdered

glass with three times its weight of pure ammonium hydrogen fluoride in presence of acid with constant stirring. The sulphur in the glass is estimated by oxidation with bromine water in the course of the decomposition of a sample with ammonium hydrogen fluoride, followed by precipitation as barium sulphate, the amount of sulphur being calculated from the difference between this and the estimation of the sulphate. For the determination of the carbonate, the sample is decomposed with 30% solution of the fluoride in a lead flask, and the carbon dioxide produced absorbed in soda-lime as in the Fresenius-Classen method.

Finely powdered glass absorbs 0·1260% of carbon dioxide by exposure to the air for eight months, but the absorption during the preparation of the sample for analysis is negligible.

Pure ammonium hydrogen fluoride is prepared by passing silicon fluoride into water and treating the hydrofluorosilicic acid formed with excess of ammonia. The solution is filtered and concentrated in a platinum dish; ammonium hydrogen fluoride crystallises on cooling; it is further purified by sublimation. A 30% solution of ammonium hydrogen fluoride is not decomposed by heating at 90°, but in more concentrated solutions decomposition occurs, a 50% solution evolving hydrogen fluoride, ammonia, and ammonium fluoride at that temperature. K. K.

Rapid Process for Estimating Phosphoric Acid. H. COPAUX (*Compt. rend.*, 1921, **173**, 656—658).—The method is based on the fact that when phosphoric acid in the presence of another acid, such as sulphuric or hydrochloric acid, is shaken with ether and an alkali molybdate the phosphomolybdic acid formed unites with ether and water to give a dense yellow liquid which is not miscible with water. The estimation is conducted in a specially designed graduated tube, which is described. Into the tube is run 10 c.c. of the phosphate solution, 10 c.c. of 20% sulphuric acid, and sufficient ether to give a layer of 3—4 mm., and the contents are mixed. To the mixture is added in five or six portions 15 c.c. of a solution of sodium molybdate containing 100 grams of molybdic anhydride per litre, the mixture being shaken after each addition. The tube is then spun in a centrifuge and when the separation of the three liquid phases is complete, the volume of the dense yellow liquid is read. The tube having been previously calibrated against a standard solution of a phosphate, the percentage of phosphoric anhydride in the solution under examination can at once be determined. If the solution contains citric acid or citrates, these must be removed by preliminary evaporation and ignition.

W. G.

Estimation of Phosphates in Waters. DANIEL FLORENTIN (*Ann. Chim. anal.*, 1921, **3**, 295—296).—The colorimetric method described depends on the production of a blue colour when a dilute phosphoric acid solution is treated with ammonium molybdate in sulphuric acid solution and a small quantity of stannous chloride. Ten c.c. of the water to be tested are treated with two or three drops of molybdate reagent (100 c.c. of 10% ammonium molybdate

solution mixed with 300 c.c. of 50% sulphuric acid) and one drop of stannous chloride solution (0·1 gram of tin dissolved in 2 c.c. of hydrochloric acid and diluted to 10 c.c.). As little as 0·01 mg. of P_2O_5 per litre yields a distinct blue coloration, the intensity of which reaches a maximum in ten minutes. Comparison with the colorations given by known amounts of phosphoric acid gives the quantity of the latter present in the test solution. W. P. S.

Detection of Pyrophosphoric Acid in the Presence of Orthophosphoric Acid and Metaphosphoric Acid. D. Balareff (*Zeitsch. anal. Chem.*, 1921, **60**, 385—392).—To detect pyrophosphoric acid in the presence of orthophosphoric acid, the solution containing the two acids is rendered slightly alkaline towards phenolphthalein, treated with a few drops of 5% copper sulphate solution and dilute acetic acid is added until the precipitate is just dissolved; a minute crystal of copper pyrophosphate is then introduced. A precipitate of copper pyrophosphate forms gradually. Another portion of the neutralised solution may be treated with silver nitrate and acetic acid; the latter dissolves the yellow silver orthophosphate, whilst the white pyrophosphate remains insoluble. If metaphosphoric acid is also present, the precipitate obtained with copper or silver salts must be further examined, since certain forms of metaphosphoric acid yield precipitates resembling those given by pyrophosphate. For this purpose, the precipitate is dissolved in nitric acid, the solution neutralised, then acidified with acetic acid, and tested with albumin solution for the presence of metaphosphoric acid. The reaction described by Berthelot and Andre (A., 1897, ii, 158, 283) is untrustworthy in the presence of metaphosphoric acid. W. P. S.

Detection of some Metals and of Arsenic in Plant and Human Organs. A. Keilholz (*Pharm. Weekblad*, 1921, **58**, 1482—1495).—The methods available for the detection of minute quantities of arsenic, copper, manganese, zinc, aluminium, and lithium have been examined, and a scheme has been drawn up and applied to the examination of the organs of the human body and of plants for these elements. The organic matter is destroyed by means of sulphuric and nitric acids, these are removed in the usual manner, and the residue is taken up in water.

Forty per cent. of the solution is examined for arsenic, 20% for lithium, and the remainder for copper, manganese, and zinc, which are removed in succession, the solution being finally examined for aluminium.

The Bloemendal modification of Marsh's apparatus was selected for the arsenic examination, the mirrors obtained being dissolved in excess of chromic acid, the excess being titrated with iodine. The arsenic in the mirror can also be determined by Ramberg's method, which depends on the reaction $As+5I+4H_2O=H_3AsO_4+5HI$; this is more suitable for exact determination of very small quantities, but requires a mechanical shaking apparatus. In the examination of urine it was found that organic arsenic compounds, such as cacodyl derivatives, are not destroyed by the ordinary

acid combustion; the permanganate method gives accurate results in these cases.

Copper is best determined electrolytically, using a platinum cathode in a platinum crucible, which serves as anode, a potential difference of 2 volts, and a current of 4—8 milliamperes. At 60—70°, two to four hours are required. The anode is weighed on a Kühlmann balance. Zinc and manganese do not interfere.

Manganese can be determined colorimetrically by Marshall's method (A., 1901, ii, 350) or electrolytically precipitated as peroxide. Zinc is best determined electrolytically in acetic acid solution in the cold. Aluminium is estimated colorimetrically with alizarin (Atack, A., 1915, ii, 842) and lithium spectroscopically.

Application of the methods worked out showed arsenic to be present sometimes in the liver, generally in urine, and in all the plants examined; copper and zinc generally in the liver, and in some plants; manganese in the liver, brains, and blood, and in some plants; aluminium was not found in human organs, but lithium was present in nearly every organ examined, and in all the plants. Tabulated results are given in milligrams of each element per kilogram of material examined. S. I. L.

New Type of Combustion Bomb made of Krupp's Special Steel. W. A. Roth, R. Macheleidt, and Irmg. Wilms (*Zeitsch. angew. Chem.*, 1921, **34**, 537—538).—A new calorimeter combustion bomb designed to replace the usual type with platinised or enamelled interior is constructed of Krupp's special acid-resisting "V_2A" steel (20—23% Cr, 6—9% Ni, 0·1—0·3% C). The bomb, which is made of either the "Langbein" or "Kroeker" type, is provided with a quartz or porcelain dish in which the substance to be burnt is placed. This is suspended in the interior of the bomb, from two hooks in the electric leads. The insulated lead is a rod of the chrome nickel steel, and the other is a tube serving for the admission of oxygen and the egress of the gases from the combustion, and is made of silver, since a small bent tube cannot yet be constructed out of the steel alloy. The bomb can be used for the combustion of all ordinary organic substances, including nitro-compounds, but it is not available for substances containing halogens or a high percentage of sulphur, the alloy not being resistant to nascent sulphuric or halogen acids. Normally, with the former category of organic compounds, including coals with 5—7% of sulphur, only about 0·2 mg. of iron is dissolved, and no nickel. This would generate approximately 0·2 cal. With the latter class of substances several mg. of both iron and nickel are dissolved from the surface of the metal. The susceptibility to attack, however, appears to grow less with use, and substances with a comparatively high sulphur content can then be successfully burnt. G. F. M.

The Determination of the Degree of Oxidation of Coals. Georges Charpy and Gaston Decorps (*Compt. rend.*, 1921, **173**, 807—811).—The oxidation of coal may take place in two ways. In the first, there is direct fixation of oxygen with a resulting increase in total weight and volatile matter. In the second, there

is simple oxidation with formation of carbon dioxide and water and a consequent diminution in total weight and a slight decrease in the percentage of volatile matter. The first reaction is the more important at low temperatures. The method proposed for determining the degree of oxidation of a sample of coal consists in powdering and sifting the coal and heating a known weight of it with 50% sodium hydroxide solution at 100° for two hours, using 10 c.c. of the solution for each gram of coal. The resulting liquid is diluted and filtered, the filtrate being acidified with sulphuric acid and made up to a known volume. To an aliquot portion an excess of standard potassium permanganate solution is added and the mixture is left at the ordinary temperature for two hours, after which the excess of permanganate is titrated back. In this way is determined the oxidation index, that is the number of grams of oxygen necessary to oxidise the organic matter dissolved by the sodium hydroxide from one kilo. of coal. Coals required to produce a resistant coke should, as a rule, have an oxidation index not exceeding 2. Curves are given showing the variation with time of the oxidation index and total weight of two samples of coal kept at 150°. W. G.

Apparatus for the Estimation of Carbon Dioxide (in Carbonates). WILHELM KOHEN (*Chem. Zeit.*, 1921, **45**, 1027).—The apparatus consists of a small reaction flask provided with a tapped funnel for the introduction of the acid; the neck of the flask is fitted with a small reflux condenser of the ball type, and this is connected with a sulphuric acid bulb and a potash bulb. The contents of the flask may be boiled to expel the last traces of carbon dioxide, the condenser and sulphuric acid bulb preventing any water vapour entering the potash bulb. W. P. S.

A New Method of Estimating Silica. TRAVERS (*Compt. rend.*, 1921, **173**, 714—717).—The silica is first converted into an alkali silicate and to it, in solution in a silver dish, is added at least 1 gram of potassium fluoride for every 0·15 gram of silica. Hydrochloric acid is added until the liquid is just neutral, and then a further 2 c.c. are added, and finally 7—10 grams of potassium chloride for every 50 c.c. of liquid. The precipitated potassium silicofluoride is collected on a hardened filter in an ebonite funnel and washed with a 20% solution of potassium chloride until free from acid. The wet precipitate is suspended in boiling water and titrated with *N*/5-potassium hydroxide, free from carbonate, using phenolphthalein as indicator. One c.c. of the alkali corresponds with 0·005 gram of silica. Details are given for the application of the method to the estimation of traces of silica in alkali hydroxides and salts, to the analysis of quartz and silicates, and to the estimation of silica in the presence of fluorine and aluminium. W. G.

Gravimetric Estimation of Potassium by the Cobalt Method. A. VÜRTHEIM (*Rec. trav. chim.*, 1921, **40**, 593—599).—A study of the conditions under which a precipitate of constant composition is given by potassium compounds with a cobalt salt

and sodium nitrite. Such a precipitate, apart from variations in water content, can be obtained: these variations are eliminated by drying at 110° to constant weight. The method is thus rendered of use for direct estimation. H. J. E.

Estimation of Potassium in Soils and Fertilisers. HARALD R. CHRISTENSEN and NIELS FEILBERG (*Landw. Versuchs.-Stat.*, 1921, **97**, 27—56).—The cobaltinitrite method of Mitscherlich (A., 1912, ii, 204, 996) is modified, whereby 5 c.c. of saturated sodium chloride solution are added together with the precipitating reagent, thereby ensuring more complete precipitation. The method is applicable to the estimation of potassium in fertilisers and soil extracts. [See further *J. Soc. Chem. Ind.*, 1921, 820A.] G. W. R.

The Acidimetric Estimation of Ammonium Salts with Formalin. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 1463—1469).—Formaldehyde reacts readily with ammonium salts in aqueous solution, forming hexamethylenetetramine and setting free the acid originally combined with the ammonia. The procedures of Gaillot (A., 1913, ii, 240) and of van Bers (A., 1917, ii, 578) have been found unsatisfactory. Very accurate results are obtained by adding 5 c.c. of formalin (B.P., neutral to phenolphthalein) to 25 c.c. of the solution (about 0·1 mol. per litre) of ammonium salt, and titrating the liberated acid after one minute with *N*/10-sodium hydroxide solution. It is equally satisfactory to use excess of soda with the formalin, titrating the excess with acid after fifteen minutes.

The sodium hydroxide must be free from carbonate, and the water used for the solutions free from carbon dioxide; phenolphthalein is used as indicator. Small quantities of neutral salts do not interfere. The method is not suitable for the accurate estimation of formaldehyde. S. I. L.

Chemical Analysis with Membrane Filters. II. Volumetric Estimation of Zinc. GERHART JANDER and HANS CAESAR STUHLMANN (*Zeitsch. anal. Chem.*, 1921, **60**, 289—321; cf. A., 1919, ii, 520).—The collection and washing of zinc sulphide precipitates are facilitated by the use of membrane filters; the sulphide should be precipitated from an acetic acid solution containing sodium acetate. Of volumetric methods for the estimation of zinc sulphide, Mann's method (decomposition of the zinc sulphide with moist silver chloride and subsequent titration of the zinc chloride) and acidimetric methods are trustworthy. W. P. S.

Sensitive Reaction for Copper. P. FALCIOLA (*Giorn. Chim. Ind. Applic.*, 1921, **3**, 354—355).—Cupric salts may be detected in solution even in 0·00001 *N*-concentration, by means of alkali thiocyanate solution mixed with cold saturated gallic acid solution, a decided turbidity being produced. The cupric solution should be neutral and free from silver, lead, and bismuth. Similar precipitation of copper occurs if the gallic acid in the reagent is replaced by tannic acid, catechol, or quinol, but not by resorcinol. [Cf. *J. Soc. Chem. Ind.*, 1921, Dec.] T. H. P.

Rapid Electro-analysis of Brass. A. LASSIEUR and (MME) A. LASSIEUR (*Compt. rend.*, 1921, **173**, 772—775).—The following details of working should be strictly adhered to. 0·5 Gram of brass in the form of thin foil is dissolved in 20 c.c. of sulphuric acid (50% by weight) and 1 c.c. of nitric acid (*d* 1·33), the liquid being heated to boiling at first. When solution is complete, the liquid is diluted to 70 c.c. with water and electrolysed, using a current of 4—5 amperes and rotating electrodes. The operation lasts forty minutes, during which the whole of the copper is deposited and the nitric acid is completely reduced. To the liquid, freed from copper and containing the rinsings of the electrodes, are added 25 c.c. of sodium hydroxide (*d* 1·33), 15 c.c. of glacial acetic acid, and 10 c.c. of a saturated solution of sodium fluoride in the order named. The liquid is cooled to the ordinary temperature and electrolysed, the zinc being deposited on a copper-coated cathode, using a current of 4 amperes. In some cases, at the end of the first electrolysis a slight deposition of zinc is noted. This zinc at once dissolves again when the current is stopped. W. G.

The Separation of Aluminium from Glucinum. II. HUBERT T. S. BRITTON (*Analyst*, 1921, **46**, 437—445; cf. this vol., ii, 657).—Aluminium cannot be separated from glucinum satisfactorily by means of ammonium carbonate in either hot or cold solutions, as not only does the precipitated aluminium hydroxide carry down considerable amounts of glucina, but much alumina remains in the ammonium carbonate solution. Treatment of a solution of the two metals with ammonium sulphite yielded, on boiling, a precipitate containing all the aluminium and much glucinum, although the latter alone gives no precipitate with the reagent. Separation by means of sodium hydrogen carbonate (Parsons and Barnes, A., 1907, ii, 52) yields satisfactory results if neither the glucinum nor aluminium in 100 c.c. of the solution saturated with sodium hydrogen carbonate exceeds 0·15 gram, and if the adsorption in both precipitations is kept at a minimum by vigorous stirring. A. R. P.

Reaction of Manganese, Iron, and Cobalt. D. BALAREFF (*Zeitsch. anal. Chem.*, 1921, **60**, 392—393).—The precipitate containing manganese and iron hydroxides is washed, dissolved in nitric acid, the solution boiled to oxidise ferrous salt, then neutralised with sodium hydroxide solution, treated with silver nitrate solution, and then rendered ammoniacal or acidified with acetic acid; in the presence of as little as 0·2 mg. of manganese per litre, a black precipitate is observed in the ammoniacal solution, or a yellowish-brown precipitate in the acetic acid solutiou. Cobalt and ferrous salts yield a similar reaction. W. P. S.

Titrations with Potassium Permanganate. ANT. JILEK (*Chem. Listy*, 1921, **15**, 105—109, 138—140).—The titration of sodium oxalate, oxalic acid, ferrous ammonium sulphate, and electrolytic iron (prepared according either to Treadwell or Classen) was studied. The results of these titrations agreed with each other more closely if the volumes of 0·1*N*-potassium permanganate used

were approximately equal. Treadwell's method did not require a control estimation. Standardisation against sodium oxalate, oxalic acid, and ferrous ammonium sulphate is very facile and accurate. Classen's method was rapid and accurate, if the iron dissolved in sulphuric acid is titrated in the presence of platinum. Solutions of 0·1*N*-ferrous sulphate, slightly acidified with sulphuric acid, and exposed to air, are practically unaffected after twenty-four to forty-eight hours. There is practically no danger of the oxidation of these solutions during their filtration through paper or glass wool.

CHEMICAL ABSTRACTS.

Volumetric Estimation of Mixtures of Permanganate, Dichromate, and Chromic Salts. NITYA GOPAL CHATTERJI (*Chem. News*, 1921, **123**, 232—233).—The method depends on the fact that permanganate is converted into hydrated manganese dioxide by treatment with a solution containing manganese sulphate and zinc sulphate, whilst dichromate is not affected. Titration of a mixture of permanganate and dichromate with ferrous sulphate solution before and after such treatment gives a measure of the amounts of the two substances present. The estimation of chromium salts is based on their oxidation to dichromate by heating with hydrated manganese dioxide in dilute sulphuric acid solution.

W. P. S.

The Iodometric Determination of Iron. I. M. KOLTHOFF (*Pharm. Weekblad*, 1921, **58**, 1510—1522).—The slowness of the reaction between ferric salts and iodides is found to be due to the hydrolysis of the former, resulting in the formation of colloidal ferric hydroxide. Strong acids accelerate the reaction, but not if present in excess, since complex ferric salts are formed. The reaction is very suitable for analytical work if the iron solution be about *M*/10, and the correction concentration of acid and iodide be obtained. For 25 c.c. of iron solution, about 2 c.c. of concentrated hydrochloric acid (25—39%) and 1·6 grams of potassium iodide are required; after fifteen minutes, the iodine is titrated with thiosulphate. Sulphates and oxalates interfere; phosphates interfere only if the solution is not sufficiently acidic. Even ferric solutions as dilute as 0·001 *M* can be accurately titrated in *N*/10-hydrochloric acid solution if sufficient iodide (0·5 gram for 10 c.c. of iron solution) be used.

S. I. L.

The Different Methods of Attack of Ochreous Minerals. A. RAYNAUD (*Bull. Soc. chim.*, 1921, [iv], **29**, 905—910).—For the analysis of the ochres, 0·5 gram of the finely-powdered mineral, previously dried at 100—105°, is weighed into a platinum crucible, strongly ignited for a few minutes, and weighed again. The loss in weight is due to water of combination and traces of carbonate and organic matter. To the residue 4—5 c.c. of dilute sulphuric acid and 8—10 c.c. of fuming hydrofluoric acid are added, and the mixture is evaporated to dryness at a gentle heat, finally heated more strongly until fuming has ceased, and then ignited. The residue, which consists of oxides of iron and alumina, is weighed,

the loss in weight by the acid treatment being reckoned as silica. The residue is fused with potassium hydrogen sulphate, and after rapid cooling the fused mass is extracted with water, the iron reduced to the ferrous state, and estimated by titration with permanganate. The percentage of aluminium oxide is got by difference from the mixed oxides. The process is rapid and gives results quite comparable with those obtained with more complicated methods. W. G.

Application of Amalgams in Volumetric Analyses. II. Estimation of Vanadium and Uranium. TAMAKI NAKAZONO (*J. Chem. Soc. Japan*, 1921, **42**, 761—768; cf. this vol., ii, 596).—Vanadium can be titrated with potassium permanganate either by reduction to (*a*) the bivalent state by shaking with liquid zinc amalgam for three minutes in the absence of air in the manner previously described (*loc. cit.*), or (*b*) to the quadrivalent state by treatment with saturated silver sulphate solution, after shaking with zinc amalgam for three seconds only.

Uranium is titrated with potassium permanganate after reduction to the quadrivalent state by shaking with zinc amalgam for thirty seconds in the presence of air. K. K.

Estimation of Fermentation Glycerol. KARL FLEISCHER (*Zeitsch. anal. Chem.*, 1921, **60**, 330—338).—One hundred c.c. of the glycerol solution (obtained by the fermentation process) is distilled under reduced pressure with superheated steam, the temperature of the distillation flask being raised gradually to 250°; the distillate is collected in a flask immersed in a water-bath at 70°. This receiving flask is provided with a reflux apparatus supplied with a current of water at 70°, and the top of the reflux apparatus is connected with an ordinary condenser, receiver, and pump. When glycerol ceases to collect in the flask, the steam supply is cut off, and the contents of the flask are heated at 100° under reduced pressure until practically all water has been removed; a small current of air is admitted to the flask through a capillary to aid in the removal of the water. The residue of glycerol in the flask is then weighed; its specific gravity is determined so that an allowance can be made for the small quantity of water still present. W. P. S.

Sugar Calculations. J. F. LIVERSEEGE (*Analyst*, 1921, **46**, 446—450).—Equations are given for correcting the specific rotatory power of a sugar or mixture of sugars for temperature and concentration and examples are given of the method of calculating the proportions of the various commercial sugars in solutions from the observed specific rotatory power before and after inversion, the value of K (that is, reduction expressed as dextrose and lævulose) before and after fermentation, and the total organic solids. A table of constants and factors for the more important sugars is also given. A. R. P.

Estimation of the Pentose Sugars. HERMAN AUGUSTUS SPOEHR (*Carnegie Inst. Pub.*, 1919, No. **287**, 36—37).—The hexose sugars

are fermented with baker's yeast, and the alcohol and other products of fermentation are removed by distillation. The residual solution containing pentoses is then caused to react with hot Fehling solution, and the cuprous oxide obtained by reduction is estimated by an iodometric titration. The non-fermentable sugar must be recognised as pentose by the proper tests. CHEMICAL ABSTRACTS.

The Quantitative Estimation of Dextrose and Lævulose in a Solution. HANS MURSCHHAUSER (*Biochem. Zeitsch.*, 1921, **118**, 120—128).—The optical rotation of the solution, and the total reducing power on copper sulphate by Pflüger's method (*Pflüger's Archiv*, 1906, **114**, 242) for dextrose are determined. Pflüger's table of reducing powers of dextrose in terms of cuprous oxide is used as the standard of reference for dextrose, and an analogous table is experimentally determined for lævulose. Knowing the optical rotation of dextrose and lævulose separately, the content of dextrose and of lævulose is determined graphically or by simple calculation. H. K.

Comparative Estimations of Lignin in Cellulose. E. HEUSER and G. WENZEL (*Papierfabr.*, 1921, **19**, 1177—1184).—The degree of accuracy of a number of methods for the estimation of lignin has been compared using a sample of unbleached, rasped Mitscherlich sulphite-cellulose, which gave the qualitative reactions for lignin distinctly, with a total solid content of 91·5%, benzene-alcohol extract (resin and fat) 1·48%, and ash 0·85%. The estimation of lignin by Becker's modification (*Papierfabr.*, 1919, **17**, 1325) of König and Rump's method (*Zeitsch. Unters. Nahr. Genussm.*, 1914, **28**, 184) using 72% sulphuric acid, gives too high results, owing to the separation on dilution of colloidal products which contain no lignin, but are weighed as such. Too high results are also obtained by König and Becker's modification (*Papierfabr.*, 1919, **17**, 565) of Krull's method (*Diss.*, *Danzig.*, 1916, 19) using gaseous hydrogen chloride, and König and Rump's method (*loc. cit.*) using dilute hydrochloric acid under pressure, owing to the incomplete saccharification of the cellulose. On the other hand, trustworthy determinations of lignin in cellulose are obtained by a modification of Willstätter and Zechmeister's method (A., 1913, i, 955), in which 1 gram of the sample is covered with 70 c.c. of 41·4% hydrochloric acid in a stoppered flask, frequently shaken during eighteen hours, diluted with ten times the volume of water, and boiled for ten minutes. F. M. R.

Estimation of Lactic Acid in Blood. G. A. HARROP, jun. (*Proc. Soc. Expt. Biol. Med.*, 1920, **17**, 126—133).—The method is based on Denigès's observation that lactic acid is converted by concentrated sulphuric acid into acetaldehyde, and can be estimated with phenols and morphine alkaloids. Five c.c. of blood or serum are heated for 4—5 minutes on a water-bath with 15 c.c. of acidified copper sulphate solution, and excess of powdered calcium hydroxide is added to the cold liquid. After thirty minutes, it is filtered, and one part of the filtrate is added to four parts of concentrated sulphuric acid while the mixture is being shaken and cooled in water

at 0°. After being placed in a boiling-water bath for two minutes, it is again cooled to 0°, three drops of a 5% solution of guaiacol are added, and after keeping for twenty minutes the rose colour which has developed is compared with standards similarly prepared.

CHEMICAL ABSTRACTS.

A Modification of Aschman's Method of Determining the Iodine Value. B. M. MARGOSCHES and R. BARU (*Chem. Umschau*, 1921, **28**, 229—232 and 245—247).—The iodine monochloride solution is prepared as follows: 15 grams of potassium iodide are dissolved in 50 c.c. of water and chlorine is passed through until the iodine at first precipitated is completely redissolved. The solution is left for five hours, and is then decanted from the crystalline precipitate, which is washed, and the solution and washings are made up to 500 c.c. with water. The solution is even more stable than Wijs's solution.

0·5—0·1 Gram of the oil or fat (according to the iodine value expected) is taken and dissolved in 10 c.c. of carbon tetrachloride and 10 c.c. of the iodine monochloride solution are added. The mixture is shaken and it is essential that the shaking is repeated two or three times during the first half of the absorption period, which varies from two to four hours for fats, six hours for non-drying, eight hours for semi-drying, and twenty-four hours for drying oils when only 60% excess of iodine is used. The time can be reduced by using a larger excess (75%) when six to eight hours are sufficient even for drying oils. The excess of iodine is titrated in the usual way. An iodine monochloride solution of half the above concentration can be used equally well. The values obtained usually lie between the corresponding Hübl and Wijs values. H. C. R.

A Modified Babcock Method for Determining Fat in Butter. N. W. HEPBURN (*Cornell Univ. Agric. Exp. Sta., Memoir* 37, 669—690).—The size of the bottle used in the Babcock cream test is modified to suit the fat estimation in butter. A 23 cm. bottle is used for 9 gram samples and a 15 cm. for 6 gram samples, the diameter of the graduated part of the neck being 9·07 and 9·04 mm. respectively for the two sizes. With the former, the semi-solid butter is covered with 9 c.c. of lukewarm water, and 17·6 c.c. of commercial sulphuric acid are added slowly and with vigorous shaking, followed by more water to bring the liquid to the graduation marks. After five minutes' centrifuging, more water is added to bring the liquid again to the graduations. The bottle is again centrifuged for four minutes and placed in a water-bath at 52—54°, and the volume of fat is read off. Glymol may be used to flatten the meniscus. The results obtained compare favourably with those from chemical analyses. The accuracy is the same with both sizes of bottle, but the 23 cm. is more easily manipulated. A. G. P.

The Estimation of Enols by Hieber's Copper Acetate Method. W. DIECKMANN (*Ber.*, 1921, **54**, [*B*], 2251—2254; cf. Hieber, this vol., ii, 466).—Hieber's method for the estimation of enols is not valid, since it depends on the assumption that the com-

plex copper salts of the latter are not affected under the experimental conditions (in alcohol–chloroform solution in the presence of an equimolecular amount of copper acetate) by an equivalent amount of acetic acid. This is true only of the copper salts of strongly acidic enols, for example, α-mesityloxideoxalic ester, but not of those derived from ethyl acetoacetate and similar substances of a more feebly acidic nature. Repetition of Hieber's experiment with " equilibrium ethyl acetoacetate " or with a specimen containing a larger proportion of enol leads to the formation of about 7·5% of the copper salt which is produced to the extent of about 11% when the quantity of copper acetate is doubled, and about 14% when the quantity is quadrupled. The reaction between ethyl acetoacetate and copper acetate does not depend on the combination of the enolic form, but on the attainment of an equilibrium between the copper compound of ethyl acetoacetate, copper acetate, and acetic acid, which, in consequence of the rapid keto-enolic transformation, is independent of the enol content of the ethyl acetoacetate. The coincidence of Hieber's datum with the known enolic content of " equilibrium ethyl acetoacetate " is purely accidental and depends on the experimental conditions and relative quantities of material; the remarkable agreement shown in other instances is doubtless conditioned by the fact that, in accordance with Classen's rule, acidity and tendency towards enolisation are, in general, parallel characteristics. The copper salts of other enols show an analogous but gradually differing behaviour from that of the compound derived from ethyl acetoacetate. The figures enclosed within the brackets represent the percentages of the substances which remain unchanged after treatment with two molecular proportions of acetic acid and one of copper acetate in alcohol–chloroform solution: ethyl copper benzoylacetate (*ca.* 38), copper acetylacetone (60), ethyl copper oxalacetate (*ca.* 85), copper benzoylacetone (*ca.* 100), methyl copper α-mesityloxide oxalate (*ca.* 100).

Hieber's method is applicable only in the few cases in which the copper salt is not attacked by acetic acid and the rate of keto-enolic transformation is so small that an alteration of the enolic content does not occur during the course of the experiment. H. W.

Estimation of Citronellol and Citronellal by Formylation. C. T. BENNETT (*Perf. and Essent. Oil Rec.*, 1921, **12**, 351).—The formic acid method for the estimation of citronellol and citronellal is absolutely untrustworthy. Even with pure citronellol, the results were high when 100% acid was used, and low with a weaker acid, and in the case of mixtures, such as otto of rose, the results are vitiated by the action of the acid on the geraniol present, which it partly converts into formate. The action of 100% formic acid on citronellol yields a mixture of products containing unchanged citronellol, a small amount of what is probably an aliphatic or cyclic terpene, citronellol formate, b. p. 99—100°/7 mm., the *compound* $OH\cdot CMe_2\cdot[CH_2]_3\cdot CHMe\cdot CH_2\cdot CH_2\cdot O\cdot CHO$, b. p. 129°/5 mm. $d=0{\cdot}9651$, $\mu=1{\cdot}4488$, $\alpha=1°\ 46''$, and the corresponding *diformate*, b. p. 140—141°/7 mm. G. F. M.

The Acid Amide Fraction of the Nitrogen of Peat. E. J. MILLER and C. S. ROBINSON (*Soil Sci.*, 1921, **11**, 457—467).—It is shown that both glutamic acid and aspartic acid are obtainable from peat by hydrolysis with hydrochloric acid. Attempts to separate glutamic acid directly from the hydrolysate were not successful. The application of Foreman's method (cf. A., 1914, ii, 826) in a slightly modified form resulted in the separation of both glutamic and aspartic acids, and in the estimation of pyrolidonecarboxylic acid from the hydrolysate. W. G.

Estimation of Cyanides Iodometrically with the aid of Benzene. NAOTSUNA KANÔ (*J. Chem. Soc. Japan*, 1921, **42**, 454—462).—Benzene can be used as an indicator in iodometry for the accurate estimation of cyanides. The original solution is mixed with 1% boric acid solution, then with the same quantity of 1% borax solution, and titrated; or impurities in the original solution are removed by addition of sodium hydrogen carbonate and after neutralisation with hydrochloric acid, the titration is performed. In each case, benzene is added to indicate the end point; when the benzene is tinged, sodium hydrogen carbonate is added, and the titration continued. The method is applicable in general iodometry, when the sample is coloured strongly or contains precipitates. The method has been used in analysing samples of potassium chromate and potassium ferricyanide. K. K.

Estimation of Thiocyanate in the Presence of Salts which Precipitate Silver Nitrate. ANDRÉ DUBOSC (*Ann. Chim. anal.*, 1921, **3**, 297—298).—To estimate thiocyanate in the presence of chlorides, etc., the sulphur in the thiocyanate is oxidised to sulphate and then precipitated as barium sulphate. The oxidation is best made with a reagent prepared by electrolysing a mixture of sodium chloride and magnesium chloride solutions; this reagent should contain 2% of "active" chlorine. A suitable quantity of the thiocyanate is dissolved in 50 c.c. of water, 50 c.c. of 4% barium chloride solution and 50 c.c. of the reagent are added, and, after ten minutes, the mixture is acidified with 10 c.c. of hydrochloric acid, boiled, and the barium sulphate collected and weighed. W. P. S.

The Estimation of Creatinine in the Presence of Acetone and Acetoacetic Acid. NATHAN F. BLAU (*J. Biol. Chem.*, 1921, **48**, 105—118).—The author demonstrates, by numerous analyses, the disturbing effects of the presence of acetone substances on the estimation of creatinine by the method of Folin. He describes a method of removing these interfering substances from urine by boiling, the temperature being kept low by the addition of methyl alcohol. C. R. H.

Estimation of the Alkaloid Content of Lupines. F. MACH and P. LEDERLE (*Landw. Versuchs.-Stat.*, 1921, **98**, 117—124).—The authors discuss the errors which may occur in the estimation of the alkaloid content of lupines by extraction with chloroform–ether and precipitation of the alkaloids by silicotungstic acid. Calculation of the alkaloid content from the weight of residue

obtained by ignition of the alkaloid–silico-tungstate precipitate is inexact because alkaloids of varying molecular weight occur in different species of lupines. In the method recommended, 15 grams of lupine meal are extracted by shaking with 100 c.c. of ether, 50 c.c. of chloroform, and 10 c.c. of 15% sodium hydroxide solution. After keeping, the ethereal layer is filtered and an aliquot part is diluted with an equal volume of ether and washed three times with 20 c.c. of 1% hydrochloric acid. The ether and chloroform are removed by evaporation and the alkaloids precipitated by 10 c.c. of 10% silicotungstic acid. The precipitate is collected in a Gooch crucible, washed with 1% hydrochloric acid, dried at 120° to constant weight, and ignited. In the case of yellow lupines, where the principal alkaloid is lupinine, the factor 0·2475 is used for calculating the amount of alkaloid from the weight of the ignited residue. For lupanine, occurring in other species, the factor 0·1744 is used. The amount of alkaloids may also be calculated from the loss on ignition of the dried precipitate. G. W. R.

Colour Reaction for Nicotine and Coniine. JUAN A. SANCHEZ (*Semana med.*, **28**, 61—64; from *Chem. Zentr.*, 1921, iv, 559).—One drop of a solution of nicotine or coniine gives on shaking with 5 c.c. of a solution of 0·5 gram of vanillin in 100 c.c. of strong hydrochloric acid a coloration varying from rose red to deep cherry red, according to the concentration. The reaction is given also by indole and scatole, but not by pyridine. The solutions, examined spectroscopically, show two bands in the green (λ 525 and 490) and one in the violet. G. W. R.

Estimation of Tannin. JOHN ARTHUR WILSON and ERWIN J. KERN (*J. Ind. Eng. Chem.*, 1921, **13**, 772—774).—Two grams of hide powder, washed previously with water, extracted with chloroform, and dried, are placed in a bottle, 100 c.c. of the tannin solution (of such concentration that the 2 grams of hide powder are more than sufficient to remove the tannin) are added, and the mixture is shaken for six hours. The mixture is then filtered through fine filter-cloth arranged in a tubular funnel and the tanned hide powder is washed by passing a slow stream of water through the funnel for about twelve hours, or until the wash water no longer gives a coloration with ferric chloride solution. The hide powder is dried in the open air for twelve hours, then for two hours in a vacuum oven, and weighed. The increase in weight represents the amount of tannin in 100 c.c. of solution.
W. P. S.

Application of the Laws of Chemical Kinetics to Quantitative Analysis. Fractional Estimation of Tannins in General and Tannins of Wine in Particular. J. CLARENS (*Bull. Soc. chim.*, 1921, [iv], **29**, 837—852).—The method is based on the fact that the oxygen absorption by tannins in wine when plotted against time indicates the presence of at least four different substances. Taking into account the oxygen absorption results and the results obtained by oxidation with potassium permanganate, the author outlines a method for calculating the relative amounts of the

different types of tannins present in a mixture such as occurs in wines. W. G.

A Possible Source of Error in Testing for Bence-Jones Protein. C. W. Miller and J. E. Sweet (*J. Biol. Chem.*, 1921, **48**, 21—22).—Attention is directed to the danger of confusion, under certain conditions, in testing urine for Bence-Jones protein, owing to the presence of protein digestion products, and also to emulsions formed with preservative toluene. C. R. H.

Necessity for Exact Hæmoglobin Estimations and Erythrocyte [Red Corpuscle] Counts. K. Bürker (*Münch. med. Woch.*, 1921, **68**, 571—573; from *Chem. Zentr.*, 1921, iv, 319—320). —The author recommends absolute estimation of hæmoglobin in blood on account of the untrustworthiness of colour index determinations. A special apparatus is devised for the estimation, whereby diluted blood after reduction with sodium thiosulphate is compared colorimetrically with a standard hæmoglobin solution. Estimations of hæmoglobin content and erythrocyte counts with the blood of certain domestic animals showed that, although the absolute values vary, the amount of hæmoglobin per unit corpuscular surface is approximately constant from one species to another. G. W. R.

The Gold Number of Commercial Gelatins. Felix A. Elliott and S. E. Sheppard (*J. Ind. Eng. Chem.*, 1921, **13**, 699—700).—The gold number expresses the number of mg. of colloid necessary to prevent the precipitation of 10 c.c. of standard gold solution by 1 c.c. of 10% sodium chloride solution. It is shown that the gold number decreases with decrease in the concentration of the gelatin solution, and that the number increases the longer the gelatin solution is kept after it has been made. There is but little difference in the protective action of various commercial gelatins, and the gold number does not bear any simple relation to those properties of chief interest to users of gelatins. W. P. S.

Analysis of Shepherd's Purse (*Capsella bursa pastoris*). Clemens Grimme (*Pharm. Zentr.-h.*, 1921, **62**, 495—499).—Estimation of the choline and acetylcholine by precipitation with alcoholic platinum chloride solution yields trustworthy results if the sample is treated previously with alcohol to precipitate and remove gum-resins (cf. Boruttau and Cappenberg, this vol., i, 487). A liquid extract of good quality should contain 14% of total solids, 3% of mineral matter, and yield at least 5% of platinum precipitate corresponding with 2·15% of choline compounds. W. P. S.

Analysis of Shepherd's Purse (*Capsella bursa pastoris*). H. Cappenberg (*Pharm. Zentr.-h.*, 1921, **62**, 560—562).—The method described by Grimme (preceding abstract) is an improvement on the original process, but the author points out that the value of liquid extract of *Capsella bursa pastoris* does not depend on the quantity of choline compounds present, since the extract contains other active principles. W. P. S.

INDEX OF AUTHORS' NAMES.

TRANSACTIONS AND ABSTRACTS.

1921.

(Marked T., and A., i and A., ii respectively.)

A.

D.

F.

K.

M.

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S.

INDEX OF SUBJECTS.

TRANSACTIONS AND ABSTRACTS.

1921.

(Marked T., and A., i and A., ii respectively.)

B.

F.

H.

O.

R.

S.

U.

V.

W.

(o-*Xylene*, *Me* : *Me* = 1:2 ; m-*xylene*, *Me* : *Me* = 1:3 ; p-*xylene*, *Me* : *Me* = 1:4.)

INDEX TO PATENTS.

ERRATA.

Vol. 112 (Abstr., 1917).

Page	Line	
ii. 167	14	*for* "hydrogen" *read* "hydrogen sulphide."

Vol. 118 (Abstr., 1920).

Page	Line	
ii. 308	5*	*for* "$3H_2PO_4$" *read* "$3H_3PO_4$."
ii. 737	5, 6	,, "**Ethyl Benzoate**" *read* "**Benzyl Benzoate.**"
	8, 14, 19	,, "ethyl benzoate" *read* "benzyl benzoate."
ii. 753	20	*after* "GARNER" *insert* "FREDERICK CHALLENGER."

Vol. 120 (Abstr., 1921).

Page	Line	
i. 62	10	*for* "**Triquinonylmethanes**" *read* "**Triquinolylmethanes.**"
	11	,, "**Tri-2-quinonylmethane**" *read* "**Tri-2-quinolylmethane.**"
	14	,, "triquinonylmethane" *read* "triquinolylmethane."
i. 63	5, 7	,, "triquinonylmethane" *read* "triquinolylmethane."
,,	8	,, "*triquinonylcarbinol*" read "*triquinolylcarbinol.*"
i. 165	25	,, "ZEIGLER" *read* "ZIEGLER."
i. 258	14	,, "nitrate" *read* "nitrite."
i. 266	2	,, "793,794" *read* "i, 793,794."
i. 330	19*	,, "GORDON" *read* "CORDON."
i. 384	9, 10	,, "*Arch. Anat. Physiol.*" read "*Virchow's Archiv.*"
i. 388	2	,, "*Soil. Sci.*, **172**," read "*Soil. Sci.*, **11**."
i. 503	2	,, "HALFTEN" *read* "HAEFTEN."
i. 511	26	,, "fluoreneoxalate" *read* "fluoreneglyoxylate."
i. 516	24	,, "**Osindole**" *read* "**Oxindole.**"
i. 566	20*	,, "M. E. FOURNEAU" *read* "E. FOURNEAU."
i. 702	26	,, "vitamin-*A*" *read* "vitamin-*B*."
i. 751	8	,, "twice" *read* "half."
i. 796	16*	,, "ethyl *r*-pinate" *read* "ethyl *r*-pinonate."
i. 914	8	,, "F. R. JONES" *read* "F. R. JONES and W. B. TISDALE."
ii. 6	13	,, "*N*-ethyl" *read* "NEt_2."
ii. 176	10*	,, "JOSEPH" *read* "JOSEF."
ii. 191	9	,, "boron" *read* "baron."
ii. 224	12*	,, "*Zeitsch. anal. Chem.*" read "*Zeitsch. angew. Chem.*"
ii. 285	14*	,, "Thompson" *read* "Thomson."
ii. 285	9*	,, "THOMPSON" *read* "THOMSON."
ii. 344	13*	,, "KOLFTHOF" *read* "KOLTHOFF."
ii. 573	3	,, "BARBOROVSKÝ" *read* "BABOROVSKÝ."
,,	4	,, "HANÁK" *read* "HANÁKOVA."
ii. 621	21*	,, "**103**" *read* "**100.**"

ii. 811, col. ii, entries under "**Rüggli**" should be under "**Ruggli**" on ii, 812.

* From bottom.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, December 2nd, 1920, at 8 p.m., Sir JAMES J. DOBBIE, D.Sc., F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society, through death, on November 19th, of Mr. John Ruffle, who was elected a Fellow on February 15th, 1872.

Certificates were read for the first time in favour of:

Harry George Belasco, B.Sc , 248, Thornton Avenue, Streatham, S.W.2.
Kan Shal Kishone Bhargava, M.Sc., 274, Maxwell Road, Pollokshields, Glasgow.
Harold Burton, B.Sc., 116, Harcourt Road, Sheffield
Jaroslav Dědek, Ing. Chem. Dr., Trojanova 339, Prague II., Czechoslovakia.
Thomas Francis, 102, Dunvegan Road, Eltham, S.E.9.
Reginald George Franklin, 28, Parkhurst Road, Holloway, N.7.
William Alfred Godby, 77, Blondel Street, Battersea, S.W.11.
John Edmund Guy Harris, B.A., B.Sc., 41, Victoria Road, Cambridge.
Harold William Victor Player, 10, Upper Park Road, New Southgate, N.11
Gordon Henry Francis Polglaze, Beach House, Polkerris, Par Station, Cornwall.
Joseph Thomas Price, M.B.E., 25, Clayfield Road, Scunthorpe, Lincs.
H. Rivington Pyne, A.M., Peajack, N.J., U.S.A.
William Robson, B.Sc., East Cramlington, Cramlington, Northumberland.
William Joseph Woodgate Rolt, 5, Honley Road, Catford, S.E.6.
Shinichi Sako, 36, Flanchford Road, Shepherd's Bush, W.12.
Cyril Sebastian Salmon, M.Sc., 112, Regent's Park Road, N.W.1.
Margaret Millen Jeffs Sutherland, D.Sc., St. Margarets, Lenzie, Glasgow.
Frederick William Turner, B.Sc., 12, Parthenia Road, Walham Green, S.W.6
Cyril Christian Wood, 94, Park Avenue South, Hornsey, N.8.

Messrs. O. A. Le Beau and S. Judd Lewis were elected Scrutators, and a ballot for the election of Fellows was held. The following were subsequently declared elected as Fellows:

James Rowland Acton.
Wallace Wright Adamson, M.B., Ch.B.
Robert William Adkin.
Charles Theodore Allder.
Sydney Back.
Alexander Barclay.
David Smeaton Bennet.
Endre Berner.
Shanti Swarupa Bhatnagar, M.Sc.
Peter Joseph Brannigan, D.Sc.
Samuel Bartol Bratley.
Walter Theodore Karl Braunholtz, B.A.
Dennis Brook Briggs, B.A.
Ralph Frederick Bromley, B.Sc.
Agnes Browne, B.Sc.
William Buckley.
Eunice Annie Bucknell.
Ernest Victor Capper.
David Cardwell, M.Sc.
Margaret Carlton, B.Sc.
Albert Edward Caunce, M.Sc.
George Frederick Cawthorn, B.Sc.
Arthur William Chapman, B.Sc.
Edward Chapman.
Kshetra Pada Chatterjee, M.Sc.
Nitya Gopal Chatterji, M.Sc.
Albert Clarke.
Arthur Walter Cox.
Mary Cunningham, M.Sc., D.Sc.
Geoffrey Saunders Currey.
Shankar Shridhar Deshapande, M.Sc.
Charles Douglas-Golding, B.A.
Royston Barry Drew, M.Sc.
Frederick Montague Dyke, B.Sc.
William Carl Eckersall.
Ernest Harold Farmer, B.Sc.
Louis Anderson Fenn, B.Sc.
Ellen Field, M.Sc.
John Henry Foulger.
Percy Arthur Reginald Freeman.
Austin William Frost.
Benjamin Fullman, B.Sc.
Krishnalal Tribhuvandas Gajjar, B.A., B.Sc.
Praphulla Chandra Ghosh.
Reginald Lindsay Grant, B.Sc. Tech.
Leonard Thomas Miller Gray.
Gerald Green, B.Sc.
Henry Frank Green, B.A.
George Walton Greggs.
Alfred Lewis Grey.
Patrick Gill Griffith.
Jenkyn Arthur Griffiths.
Praphulla Chandra Guha, M.Sc.
George Thomas Gurr.
Ernest Guy, M.Sc.
Robert Thomas Moline Haines.
George Frederick Hall, B.Sc.
Eric Adolphus Halm, M.A.
Frances Mary Hamer, M.Sc.
Robert Bruce Harley, B.Sc.
John Macvie Hill.
Martin John Hoare.
Ronald Temple Holden.
Edna Elizabeth Holmes.
John Stanley Ismay.
Harry Millar Jacobs.
Mary Johnson.
Archibald Orton Jones, M.A.
Levi David Jones, B.Sc.
Hilda Mary Judd, B.Sc.
Amin Ibrahim Mohammad Kahil.
Robert Kingan.
Jagadindranath Lahiri, M.Sc.
Arthur Gameson Lane, B.Sc.
Frederic Norman Lawler.
May Sybil Leslie, D.Sc.
Samuel Edward Lewis.
Stuart Leslie Litchfield.
Norman Veitch Lothian, B.Sc., M.B., Ch.B.
Laurence Patrick McHatton.
Kenneth Gerard Mackenzie, Ph.B., M.S.
Phyllis Violet McKie, M.Sc.
Ida Smedley MacLean, D.Sc.
John Melven Macqueen, B.Sc.
Robert Edwin Witton Maddison.
William Marsh.
Rupert Aubrey Maund, M.C.
Frances Mary Gore Micklethwait, M.B.E.

Arthur George Milligan, B.Sc.
Paul Michael Mooney, B.Sc.
David Shand Munro.
David Nealy, B.Sc.
Thomas Edward Newby, B.Sc.
Lewis Charles Nickolls.
Owen Owen.
Charles Hardwicke Palmer.
Joseph Patterson, B.A.
Don Joseph Nicholas Perera, B.Sc.
Krishna Parameswaran Pillai, B.A.
Frederic William Pinkard, B.Sc.
Walter James Powell.
Thomas Alfred Quilliam, B.Sc.
Ernest George Radley.
Ralph Howard Raine.
William Randerson.
Edward Robert Redgrove.
Nora Renouf.
William Preston Riley
Idris Cheer Roberts, B.Sc.
Thomas Albert Roberts.
Gilbert Wooding Robinson, M.A.
Albert Parsons Sachs, M.A.
Haridas Saha.
George Barnes Salkeld.
John Raymond Eden Sansom, B.Sc.
Ramanlal Gokaldas Saraiya, B.A., B.Sc.
William Hill Saunders.
Max Hans Schindler.
Kumud Bihari Sen, M.Sc.
Adolphe Gladstone Millott Severn, M.D.
Harry Sharpe, B.Sc.
Ernest Alfred Wenhaston Shaw.
Thomas Francis Toplis Silva.
John Scowcroft Skelton.
Robert Samuel Smith.
Marion Crossland Soar, B.Sc.
Frederick George Soper, B.Sc.
Corbet Page Stewart, B.Sc.
Gordon Murray Stockley.
Ronald Sutcliffe, M.A.
Millicent Taylor, D.Sc.
Gartha Thompson, B.Sc.
Walter Thompson, B.Sc.
Frank Stanley Thurston, B.Sc.
Marc Tiffeneau, D. ès Sc.
Leslie Herbert Trace.
John William Ware.
Herbert Ben Watson, B.Sc.
Martha Annie Whiteley, O.B.E., D.Sc
Sibyl Taite Widdows, B.Sc.
Evelyn Caryl Bootle Wilbraham, O.B.E., Ph.D.
Sidney William Wilding.
John Sanders Wilkes.
Florence Mary Wood, B.Sc.
Olive Workman, M.Sc.
Edward Bernard Young.
Sylvester Solomon Zilva, D.Sc., Ph.D.

The following papers were read:

"Varying valency of platinum with respect to mercaptanic radicles." By Sir Prafulla C. Rây.

"The influence of the solvent on the velocity of certain reactions. Part II. Temperature-coefficients. A test of the radiation hypothesis." By H. E. Cox.

"Hyenanchin and other constituents of *Hyenanche globosa.*" By T. A. Henry.

"The methylation of cellulose. Part III. Homogeneity of product and limit of methylation." By W. S. Denham.

Ordinary Scientific Meeting, held in the Lecture Hall of the Institution of Mechanical Engineers on Thursday, December 16th, 1920, at 8 p.m., Sir JAMES J. DOBBIE, M.A., D.Sc., F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society, through death, of:

	Elected.	Died.
Sir William de Wiveleslie Abney	Dec. 2nd, 1871.	Dec. 2nd.
Franklin Wise Howorth	Feb. 18th, 1903.	Aug. 15th.
Alexander Muirhead	Mar. 30th, 1870.	Dec. 13th.
Spencer Percival Umfreville Pickering	Feb. 7th, 1878.	Dec. 15th.

Certificates were read for the first time in favour of:

Eric Newmarch Allott, B.A., 20, Cromwell Road, Stretford, Manchester.
Henry Reason Ambler, B.Sc., 45, Clifford Road, East Finchley, N.2
Reginald Robert Bird, B.Sc., 217, Newport Road, Cardiff.
Cecil Harry Chester, 6, Halfpenny Lane, Featherstone, Pontefract.
James Wilfred Cook, B.Sc., 6, Snowbury Road, Fulham, S W.6
Harry Halls, 46, Jesmond Avenue, Toller Lane, Bradford
John Harwood, M.Sc., 12, Cecil Street, Manchester.
Stanley William Hayter, 27, Birchanger Road, S. Norwood, S.E.25.
John Henry Hobbs, 2, Trevarno Terrace, Tovil, Maidstone.
Reginald Huddart, B.Sc., 30, Blessington Road, Lewisham, S E.13.
William Ogilvy Kermach, M.A., B.Sc., 16, Walton Well Road, Oxford.
Thomas Lawson McEwan, B.Sc., Oakfields, Brampton Road, Bexleyheath.
George Williams Maude, West View, London Road, Elworth, Sandbach.
William Lambert Myers, B.A., 61, Prospect Avenue, Ossining, New York.
Rokuro Nakaseko, Muromachi-Demizu, Kyoto, Japan.
Henry Phillips, B.Sc., 72, Ferntower Road, Highbury, N.5.
Richard Preston, B.Sc., 2, Islington, Liverpool.
John Welsh Stewart, 6, Bank Street, Hillhead, Glasgow.
Robert Cornthwaite Streatfeild, 49, Rotherhithe Street, S.E.16.
Albert Taylor, B.Sc., 17, Cartwright Street, Hooley Hill, Manchester.

Certificates have been authorised by the Council for presentation to ballot under Bye-Law I (2) in favour of:

Walter James Gyton, P.O. Box 699, Bulawayo, S. Rhodesia.
Herbert Vernon Hawley, 6Q, Yamashitacho, Japan.
Stefan Minovici, 32, Bulevardul Carol. Bucuresti, Rumania.

Sir Robert Robertson, K.B.E., F.R.S., then delivered his Lecture on "Some Properties of Explosives." A vote of thanks to the Lecturer, proposed by Prof. Donnan, seconded by Mr. Macnab, and supported by Sir Frederick Nathan, was carried with acclamation, and acknowledged by Sir Robert Robertson.

EMIL FISCHER MEMORIAL LECTURE.

Until further notice, Reprints of the Emil Fischer Memorial Lecture, price One Shilling and Sixpence each post free, can be obtained from the Assistant Secretary, Chemical Society, Burlington House, Piccadilly, W. 1.

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Hartmann, Konrad. Sicherheitseinrichtungen in chemischen Betrieben. (Chem. Tech. in Einzeldarstellungen.) Leipzig 1911. pp. viii+312. ill. (*Recd.* 6/11/20.)

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paper, leather and other materials. New York 1920. pp. xvi + 768. ill. 57*s*. 6*d*. net. (*Recd.* 14/12/20.)

MINISTRY OF MUNITIONS, Department of Explosives Supply. Preliminary studies for H.M. Factory Gretna, and Study for an installation of phosgene manufacture. London [1920]. pp. xvi + 145. ill. 15*s*. net. (*Recd.* 6/12/20.)

NASKE, CARL. Zerkleinerungsvorrichtungen und Mahlanlagen. (Chem. Tech. in Einzeldarstellungen.) 2nd edition. Leipzig 1918. pp. x + 278. ill. (*Recd.* 6/11/20.)

ROSCOE, THE RIGHT HON. SIR HENRY ENFIELD, and SCHORLEMMER, CARL. A treatise on chemistry. Vol. I. The non-metallic elements. 5th edition, revised by JOHN CANNELL CAIN. London 1920. pp. xvi + 968. ill. (*Reference.*) 30*s*. net.

SINDALL, ROBERT WALTER. Paper technology: an elementary manual on the manufacture, physical qualities and chemical constituents of paper and of paper-making fibres. 3rd edition. London 1920. pp. xvi + 338. ill. 21*s*. net. (*Recd.* 16/11/20.)

SLOANE, THOMAS O'CONOR. Liquid air and the liquefaction of gases. 3rd edition. London 1920. pp. 394. ill. 21*s*. net. (*Recd.* 16/11/20.)

STEIN, MILTON F. Water purification plants and their operation. 2nd edition. New York 1919. pp. x + 270. ill. 16*s*. 6*d*. net. (*Recd.* 19/11/20.)

VOGEL, J. H., and others. Das Acetylen: seine Eigenschaften, seine Herstellung und Verwendung. (Chem. Tech. in Einzeldarstellungen.) Leipzig 1911. pp. viii + 294. ill. (*Recd.* 6/11/20.)

WALLIS-TAYLER, A. J. Refrigeration, cold storage, and ice-making . . . with which is incorporated "Refrigerating and ice-making machinery" (4th edition). 6th edition. London 1920. pp. xxiv + 652. ill. 15*s*. net. (*Recd.* 16/11/20.)

WHITBY, GEORGE STAFFORD. Plantation rubber and the testing of rubber. London 1920. pp. xvi + 560. ill. 28*s*. net. (*Recd.* 16/11/20.)

III. *Pamphlets.*

BURGESS, GEORGE KIMBALL. Temperature measurements in steel furnaces. New York 1919. pp. 8.

—— Science and the after-war period. (From the *Sci. Monthly*, Feb. 1919.)

—— Governmental research. (From the *Sci. Monthly*, Oct. 1920.)

CONJOINT BOARD OF SCIENTIFIC SOCIETIES. Metric Committee.

Report on compulsory adoption of the metric system in the United Kingdom. London [1920]. pp. 70.

IMPERIAL MINERAL RESOURCES BUREAU. The Mineral Industry of the British Empire and Foreign Countries. War Period. Arsenic. (1913—1919.) London 1920. pp. 19.

—— —— Borates. (1913—1919.) London 1920. pp. 24.

—— —— Chrome ore and chromium. (1913—1919.) London 1920. pp. 29.

—— —— Felspar. (1913—1919.) London 1920. pp. 16.

—— —— Fuller's earth. (1913—1919.) London 1920. pp. 15.

—— —— Magnesite. (1913—1919.) London 1920. pp. 42.

—— —— Monazite. (1913—1919.) London 1920. pp. 15.

—— —— Nitrates. (1913—1919.) London 1920. pp. 28.

MINISTRY OF AGRICULTURE AND FISHERIES. Damage to fisheries by pollution. London 1920. pp. 6.

SCIENTIFIC AND INDUSTRIAL RESEARCH, Department of. Bulletin No. 1. Memorandum on the preservation of timber in coal mines. By PERCY GROOM.

—— Bulletin No. 2. Memorandum on cutting lubricants and cooling liquids, and on skin diseases produced by lubricants. London 1918. pp. 8.

—— Advisory Council. Report of the Lubricants and Lubrication Inquiry Committee. London 1920. pp. 126. ill.

—— Food Investigation Board. Special Report No. 1. On the design of railway wagons for the carriage of perishable foods. London 1919 pp. 8.

—— —— Special Report No. 2. The literature of refrigeration. London 1919. pp. 8.

—— —— Special Report No. 4. Interim report on methods of freezing fish, with special reference to the handling of large quantities in gluts. London 1920. pp. ii + 50. ill.

—— Fuel Research Board. Report for the years 1918, 1919, etc. London 1920 + . ill.

—— —— Fuel for motor transport: an interim memorandum. London 1920. pp. 10

—— —— Special Report No. 2. The peat resources of Ireland. A lecture given before the Royal Dublin Society, 5th March, 1919, by PIERCE F. PURCELL. London 1920. pp. 25. ill.

—— —— Special Report No. 3. The coal fire. A research by MARGARET WHITE FISHENDEN for the Manchester Corporation Air Pollution Advisory Board. London 1920. pp. 112. ill

WEST, CLARENCE JAY. Reading list on molasses. Cambridge, Mass. 1920. pp. 52.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, January 20th, 1921, at 8 p.m., SIR JAMES J. DOBBIE, D.Sc., F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society, through death, of the following Fellows:

	Elected.	Died.
Harding Bickford	Dec. 5th, 1901.	—
Sir Lazarus Fletcher	Dec. 3rd, 1885.	Jan. 6th, 1921.
William Shepperson	May 2nd, 1901.	Dec. 14th, 1920.
Charles Simmonds	June 15th, 1899.	Jan. 15th, 1921.
Samuel Archibald Vasey	Mar. 1st, 1883.	Jan. 7th, 1921.

E. H. Farmer, W. Singleton, E. Newbery, W. J. Powell, L. C. Nickolls, E. B. Young, H. Williams, A. I. M. Kahil, J. G. Bearn, P. C. L. Thorne, W. Randerson, A. G. Rendall, J. M. Macqueen, G. T. Gurr, I. S. Maclean, S. T. Widdows, M. A. Whiteley, N. Renouf, E. A. Bucknell, and O. Workman were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

Charles Frederick Allpress, B.Sc., 6, Drayton Road, Kings Heath, Birmingham.
Frederick Blevins, 14, Talwin Street, Bromley, E.3.
Benjamin Talbott Brooks, B.A., Ph.D., 25, West 43rd Street, New York City, U.S.A.
Henry Burgess, B.Sc., 41, Second Avenue, Selly Park, Birmingham.
Eileen Mary Chatt, B.Sc., 95, South Hill Park, Hampstead, N.W.3.
Percival Walter Clutterbuck, 173, Park Lane, Leeds.
Albert Edward Cox, 9, Lombolle Road, Hampstead, N.W.3.
Arthur Henry Ford-Moore, 157A, Kensington High Street, W.8.
Gilbert Haydon, 2, Holland Road, Hornsey, N.8.
Wilfred John Hickinbottom, B.Sc., 46, Frederick Road, Stechford, Birmingham.
Thomas Harold Hooper, B.Sc., 13, Brooklands Terrace, Swansea.
David Graham Hopkins, B.Sc., 43, Rhondda Street, Swansea.
Cedric William Jacob, 2, Beech Lawn, Waterloo, Liverpool.
Charles Philip Jones, 59, Voelas Street, Princes Park, Liverpool.
Harold Lamb, 49, Dodworth Road, Barnsley.
Grace Cumming Leitch, M.A., Ph.D., B.Sc., Bonnygate, Cupar.
Alfred Ellis Levey, Horton Cottage, Market Place, Hornsea, Hull.
Robert Rankine Lynn, 8, Windsor Quadrant, Kelvinside, Glasgow.

Quentin Bradbury McKenzie, 10, Canning Street, Launceston, Tasmania.
Ralph Frederick John McKeon, 11, Spurstowe Road, Hackney, E.8.
Admed Hussein Mamish, Court of Appeal, Cairo.
Walter Mason Miles, 176, Dyke's Hall Road, Hillsborough, Sheffield.
Allan Ernest Mitchell, B.Sc., 25, Gower Street, W.C.1.
Edwin William Cecil Moir, 10, Marlborough Road, Lewisham, S.E.13.
Olive May Panderson, 35, Dryden Street, Holderness Road, Hull.
Wilfred Pohl, B.Sc., Woodville, Hockley, Essex.
William Clifford Quick, 13, Brighton Road, Weston-super-Mare.
Harold Roberts, 58, Smedley Road, Cheetham, Manchester.
Ernest Whitworth Rowley, 17A, Pierremont Crescent, Darlington.
Leonard Seal, Bank Chambers, 1, Town Hall Square, Bradford.
Nagendra Nath Sen, M.Sc., 37, Anthony Bagan Lane, Calcutta.
Lionel George Alwyne Sims, 113, Blackpool Street, Burton-on-Trent.
William Alfred Squance Hill, Shebbear, Highampton, Devon.
Marjory Stephenson, Romsey House, Cambridge.
Thomas Weston Johns Taylor, B.A., Brasenose College, Oxford.
Edward Henry Thierry, B.Sc., 27, Madeley Road, Ealing, W.5.
John Frederick Wilkinson, B.Sc., Holmwood, Davenport Park, Stockport.

The following papers were read:

"The formation of derivatives of tetrahydronaphthalene from γ-phenyl fatty acids." By G. A. R. Kon and A. Stevenson.

"Quantitative reduction by hydriodic acid of halogenated malonyl derivatives. Part I. The amides and *s*-di-alkyl- and -aryl-substituted amides of mono- and di-bromomalonic acid." By J. V. Backes, R. W. West, and M. A. Whiteley.

"Dihydroxynaphthaldehydes." By G. T. Morgan and D. C. Vining.

"Researches on residual affinity and co-ordination. Part III. Reactions of selenium and tellurium acetylacetones." By G. T. Morgan and H. D. K. Drew.

"*o*-Chlorodinitrotoluenes. Part II." By G. T. Morgan.

"The constitution of catechin. Part III. Synthesis of acacatechin." By M. Nierenstein.

"Chlorine overvoltages." By E. Newbery.

"The influence of mercury, sulphur, arsenic, and zinc on the catalytic activity of platinum." By E. B. Maxted.

"The conditions underlying the formation of unsaturated and of cyclic compounds from halogenated open-chain derivatives. Part I. Products derived from α-halogenated glutaric acids." By C. K. Ingold.

INFORMAL MEETING.

There will be an Informal Meeting on February 3rd, 1921, following the formal business of the Ordinary Scientific Meeting, at 8 p.m., and an exhibit of Glass Apparatus will be arranged.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

BARROWCLIFF, MARMADUKE, and CARR, FRANCIS HOWARD. Organic medicinal chemicals: (synthetic and natural). London 1921. pp. xiv + 331. ill. 15*s*. net. (*Recd.* 22/12/20.)
From the Authors.

ENSOLL, ROBERT. The technical chemists' pocket-book, containing a collection of notes, tables, and data useful to technical chemists, metallurgists, and chemical engineers. London 1921. pp. viii + 196. ill. (*Reference.*) 8*s*. 6*d*. net.
From the Publishers: Messrs. E. and F. N. Spon, Ltd.

FOWLE, FREDERICK EUGENE. Smithsonian physical tables. 7th edition. Washington 1920. pp. xlvi + 450. (*Reference.*)
From the Smithsonian Institution.

IMPERIAL INSTITUTE. Indian Trade Enquiry. Reports on hides and skins. London 1920. pp. x + 123. 6*s*. net. (*Recd.* 29/12/20.)

—— —— Reports on oil-seeds. London 1920. pp. x + 149. 6*s*. net. (*Recd.* 29/12/20.)

—— —— Reports on rice. London 1920. pp. x + 164. 6*s*. net. (*Recd.* 29/12/20.) From the Director.

LUMB, A. D. The platinum metals. (Imperial Institute Monograph on Mineral Resources.) London 1920. pp. x + 63. 3*s*. 6*d*. net. (*Recd.* 29/12/20.) From the Director.

RONALDSON, J. H. Coal. (Imperial Institute Monograph on Mineral Resources.) London 1920. pp. x + 166. ill. 6*s*. net. (*Recd.* 29/12/20.) From the Director.

SADTLER, SAMUEL SCHMUCKER. Chemistry of familiar things. 3rd edition. Philadelphia [1920]. pp. xiv + 322. ill. 10*s*. 6*d*. net. (*Recd.* 21/12/20.)
From the Publishers: Messrs. J. B. Lippincott Co.

WASHINGTON, HENRY STEPHENS. Chemical analyses of igneous rocks published from 1884 to 1913, inclusive, with a critical discussion of the character and use of analyses. (*U.S. Geological Survey. Professional Paper 99.*) Washington 1917. pp. 1201. (*Reference.*)
From the Department.

II. *By Purchase.*

BERTRAND, GABRIEL, and THOMAS, PIERRE. Practical biological chemistry. Translated by HECTOR A. COLWELL. London 1920. pp. xxxii + 348. ill. 10*s*. 6*d*. net. (*Recd.* 16/12/20.)

JONES, WALTER. Nucleic acids, their chemical properties and physiological conduct. 2nd edition. London 1920. pp. viii + 150. 9*s*. net. (*Recd.* 16/12/20.)

MOLINARI, ETTORE Treatise on general and industrial organic chemistry. Part i. [2nd edition.] Translated from the 3rd Italian edition by THOMAS HENRY POPE. London 1921. pp. xvi + 456. ill. 30*s*. net. (*Recd.* 16/12/20.)

III. *Pamphlets.*

BOWLES, OLIVER. Blasting granite with compressed air. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 3.

BOWLES, OLIVER, and CRAWSHAW, J. E. A fatal blasting accident. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 3.

CLARK, FREDERICK C. Paper testing methods: microscopical, chemical, and physical processes described, with an account of the apparatus employed. New York 1920. pp. 24. ill.

COLLOM, R. E. Notes on spontaneous explosions in oil and gas wells . . . North Texas. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 8.

FREDERICK, ROBERT C. The conversion of air into a lethal mixture of gases by storage of tobacco and other vegetable substances. (From the *J. Hygiene*, 1920, **19**.)

HARRINGTON, D., and DYER, B. W. Dangers from explosives fumes in metal mining. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 3.

HOWELL, SPENCER P. The menace of opening kegs of black blasting powder with wooden tools. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 3.

HOWELL, SPENCER P., and COLBURN, C. LORIMER. Misfires in metal mining. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 3.

LOGIE, W. J. On the synthesis of tryptophane by certain bacteria and on the nature of indole formation. (From the *J. Path. Bact.*, 1920, **23**.)

MUNROE, CHARLES EDWARD, and HOWELL, SPENCER P. Modified TNT as a blasting explosive. (*U.S. Bureau of Mines. Reports of Investigations.*) 1920. pp. 4.

—— —— Products of detonation of TNT. (From the *Proc. Amer. Phil. Soc.*, 1920, **59**.)

—— —— TNT as a blasting explosive. (*U.S. Dept. Agric.*, Circular 94.) 1920. pp. 24. ill.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE BALLOT TO BE HELD AT THE ORDINARY SCIENTIFIC MEETING ON THURSDAY, FEBRUARY 17, 1921.

ALLOTT, ERIC NEWMARCH, B.A., 20, Cromwell Road, Stretford, Manchester. Demonstrator in organic chemistry, Oxford University. Have taken the final honour School of Natural Science, in the subject of chemistry, at Oxford, and am at present engaged in research work. (*Signed by*) H. Hartley, N. V. Sidgwick, E. Hope, A. F. Titley, *W. H. Perkin.*

ALLPRESS, CHARLES FREDERICK, 6, Drayton Road, King's Heath, Birmingham. Lecturer in chemistry, Armstrong College, Newcastle-on-Tyne. B.Sc. (Birmingham); A.I.C.; chemist at H.M.F. Site "B," Oldbury, 1915-17; joint author, with Dr. Challenger, "Organo-derivatives of Bismuth," Part II, T., 1915, **107**, 16; a further year's research work carried out in conjunction with Dr. Challenger at Birmingham University, session 1919-1920. (*Signed by*) P. Phillips Bedson, W. N. Haworth, J. A. Smythe, Frederick Challenger.

AMBLER, HENRY REASON, 45, Clifford Road, East Finchley, N.2. Research in physical chemistry at University College, London. London, 1st class B.Sc. Honours (Chemistry), 1920; occupied in research on solubility of salts. My reason in seeking admission is to remain in touch with theoretical chemistry, my course of lectures being now completed. (*Signed by*) F. G. Donnan, J. N. Collie, D. Ridge, A. W. R. Joachim.

BELASCO, HARRY GEORGE, 48, Thornton Avenue, Streatham Hill. Research student in training. Degree, B.Sc. (London); one year's experience in steel analysis at Government Laboratory (St. Clement's Inn); two years' experience as a junior lecturer at Battersea Polytechnic. (*Signed by*) Robert H. Pickard, Joseph Kenyon, J. L. White.

BHARGAVA, KAU SHAL KISHORE, M.Sc., 274, Maxwell Road, Pollokshields, Glasgow. Student in sugar manufacture at the Royal Technical College; M.Sc. in chemistry; stood first in the M.Sc. examination; wrote a paper on the "Possibilities of Mineral Developments in Rajputana" (India); served as honorary assistant professor of chemistry in Maharaja's College, Jaipur (India), for one year. (*Signed by*) Thomas Gray, Robt. S. Glennie, James McCutcheon.

BIRD, REGINALD ROBERT, 217, Newport Road, Cardiff. Industrial chemist. Graduated as B.Sc. in University of Bristol, 1920, having been student there from 1912-1914 and 1919-1920, serving the intermediate five years in H.M. Forces. Elected as A.I.C., November, 1920; now employed as chemist at tar distillery. (*Signed by*) John C. Mann, Claude M. Thompson, H. E. Cox.

BLEVINS, FREDERICK, 14, Talwin Street, Bromley-by-Bow, E.3. Works manager, starch works. Engaged in the manufacture of heavy chemicals for over twenty years with Messrs. Brunner, Mond & Co., Ltd., as works chemist. (*Signed by*) Thornton C. Lamb, S. Glasstone, H. T. S. Britton.

BROOKS, BENJAMIN TALBOTT, 25, West 43rd Street. New York City, N.Y. Chemical engineer, Mathieson Alkali Works. Inc., New York, U.S.A. B.A., Ohio State University, 1906; Ph.D., University of Göttingen, 1912; assistant chemist, U.S. Bureau of Standards, 1907; research chemist, Philippine Bureau of Science, 1908, 1909, 1910; graduate student, University of Göttingen, 1911-1912; Professor of Industrial Chemistry, University of Pittsburgh, 1913-1917; industrial work, New York City, 1917 to date; published research papers, petroleum and essential oils. (*Signed by*) Thos. R. Duggan, William S. Myers, Chas. Baskerville.

BURGESS, HENRY, 41, Second Avenue, Selly Park, Birmingham. Research student. First division B.Sc. (Birmingham), June, 1919, with a University scholarship; June, 1920, first class B.Sc. Honours degree and Priestley Scholarship awarded. I am working under an industrial research grant. (*Signed by*) G. T. Morgan, S. R. Carter, H. D. K. Drew, John D. Smith, H. Gordon Reeves.

BURTON, HAROLD, 116, Harcourt Road, Sheffield. Research assistant under Dr. Kenner at the University, Sheffield. Bachelor of Science (Honours chemistry, 1st class), Sheffield. I wish to obtain the publications so as to keep in touch with recent chemical work. (*Signed by*) W. P. Wynne, J. Kenner, F. G. Tryhorn, Thos. B. Smith, Ernest Witham, W. E. S. Turner.

CARRICK, JOSEPH MICHAEL, 32, Ulverton Road, Dalkey, Co. Dublin, Ireland. Pharmaceutical chemist. Licentiate and Member of the Pharmaceutical Society of Ireland. (*Signed by*) Wm. Boulton Conyngham, T. Slater Price, G. I. Higson, *William Caldwell, Walter Thorp, E. B. Fairweather.*

CHATT, EILEEN MARY, 95, South Hill Park, Hampstead, N.W.3. Temporary chemical assistant in the Government laboratory. B.Sc., Hons. Chem., London; A.I.C.; five years' experience in analytical work. I wish to join the Chemical Society in order to keep in touch with the developments of chemical science. (*Signed by*) James Connah, Geo. Stubbs, J. J. Fox, J. R. Nicholls.

CHESTER, CECIL HARRY, 6, Halfpenny Lane, Featherstone, Yorkshire. Chemist. Studied in chemistry, Wakefield Academy, Grammar School, and Leeds University; served articles to H. Townsend. M.Inst.C.E., of Wakefield; later became chief chemist and technical assistant to the Wakefield Gas Light Company, with charge of residual plant, etc. Appointed chemist to Bale & Hardy, Ltd., nine months ago, and through chemical investigation have been able to solve many troubles. (*Signed. by*) R. Lessing, J. Harger Pye, J. W. Napier.

CLARKE, THOMAS, "Anzac," 36, Lansdowne Road, Tottenham, N.17. Chemical engineer with Lennox Foundry Co., Ltd., London. Intermediate B.Sc. London, engineering and chemistry; studying chemistry in Lennox Research Laboratory. (*Signed by*) Robert N. Lennox, William T. Burgess, W. Farrant.

CLEWS, FRANCIS HERBERT, 26, Elm Street, Burslem, Stoke-on-Trent. Assistant lecturer. M.Sc., Birmingham. Joint author with Mr. Wardlaw and Mr. Carter of two papers on the "Oxidising Properties of Sulphur Dioxide," published in the *Trans. Chem. Soc.*, Oct., 1920. (*Signed by*) G. T. Morgan, S. R. Carter, Wm. Wardlaw, A. E. Goddard, H. V. Thompson.

CLUTTERBUCK, PERCIVAL WALTER, 173, Park Lane, Leeds. Student of chemistry. Entered the Leeds University in October, 1914, for the Honours degree course in chemistry; volunteered for the gas and trench mortar section in January, 1916; went to the R.E. experimental station at Porton as chemist in June, 1916, and remained until January, 1919; since then have

continued the honours course at Leeds and carrying out research with Prof. Cohen. (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson, W. Lowson, P. K. Dutt.

COOK, JAMES WILFRED, 6, Snowbury Road, Fulham, S.W.6. Chemist. B.Sc. (London); demonstrator of organic chemistry at the Sir John Cass Technical Institute. (*Signed by*) E. de Barry Barnett, P. C. L. Thorne, Henry J. S. Sand.

COX, ALBERT EDWARD, 9, Lambolle Road, Belsize Park, Hampstead, N.W.3. Analytical chemist. Student of Institute of Chemistry; five years assistant to Dr. Muter, 325, Kennington Road, London, S.E.; three years works chemist, Cotton Powder Co., Ltd., Faversham, Kent; one year analyst and bacteriologist to Express Dairy Co., London, W.C. (*Signed by*) Arthur S. Carlos, J. I. M. Jones, R. MacInnes.

DALRYMPLE, GEORGE ANDREW, 16, Ampthill Road, Liverpool. Chemist. Head of the laboratory department of Evans, Sons, Lescher, and Webb, Ltd., Liverpool, for fifteen years; in charge of the manufacture of a large number of chemicals and pharmaceutical preparations. (*Signed by*) W. Ramsay Sibbald, Thomas J. Roberts, Arthur A. Dallman, George Tate, *H. C. Reynard.*

DĚDEK, JAROSLAV, ING.-CHEM., Prague II, Trojanova 339, Czecho-slovakia. Assistant at the Research Institute for Sugar Industry, Prague. Chemical Engineer; D.Chem. (Prague); published in the Reports of the Academy of Science (Prague), and in the *Cukrovarnické listy* (Sugar Journal), Prague; half year at A.G.F.A. (Berlin); one year priv.-assistant at the University, Prague. (*Signed by*) H. J. Backer, Jaroslav Heyrovský, T. Martin Lowry.

DOUGHTY, JOSEPH NEATBY, 33, Clarkehouse Road, Sheffield. Student (University of Sheffield). B.Sc. (Sheffield) in chemistry and physics; preparing for M.Sc. with a view to becoming research chemist in works. I wish to become a Fellow in order to get the Society's journals and other publications, and to make use of the Society's library. (*Signed by*) W. P. Wynne, J. Kenner, John Evans, F. G. Tryhorn, Thos. B. Smith, H. E. Cox.

FORD-MOORE, ARTHUR HENRY, 157A, Kensington High Street, W.8. Industrial chemist (dye works). Entrance scholar (Natural Science), Trinity College, Cambridge (1915); at present working for Part II. Natural Science (Chemistry) Tripos. (*Signed by*) A. J. Berry, Hamilton McCombie, F. H. Lowe.

FRANCIS, THOMAS, 102, Dunvegan Road, Eltham, S.E.9. Science master, Bostall Lane L.C.C. School, Abbey Wood, S.E.2. Responsible master at Elizabeth Street General Evening Institute, North Woolwich, E.10. Fourteen years science master at Bostall Lane L.C.C. School; sometime lecturer in science at Erith Technical Inst.; three years science student at Bloomfield Road Science School; four years responsible master, Elizabeth Street Evening Institute. (*Signed by*) Alex. F. Hogg, Charles Oliver Barber, Fred. C. Smith.

FRANKLIN, REGINALD GEORGE, 28, Parkhurst Road, Holloway, N.7 Student. Three and a-half years' training in laboratory of engineering works; (now) second year student (Hons. Chemistry) at King's College, W.C. (*Signed by*) Samuel Smiles, A. J. Allmand, H. T. S. Britton, S. Glasstone.

GODBY, WILLIAM ALFRED, 77, Blondel Street, Battersea, S.W.11. Laboratory assistant to Chief Inspector of Foods, Ministry of Health, Whitehall. Attended Battersea Polytechnic for four years as lecturer assistant to Dr. J. L. White, D.Sc., etc., and Mr. J. Wilson, M.Sc., F.I.C., etc. Having passed chemical examination at the same institute in first and second year

inorganic chem., pract. and theory, and first and second year organic, pract. and theory; now acting as assistant to Dr. Monier-Williams, M.A., Ph.D., F.I.C., etc., with a view to becoming fully qualified in food analysis, so as to be able to take up a position at some future date as a food analyst. (*Signed by*) G. W. Monier-Williams, J. Wilson, J. L. White.

HALLS, HARRY, 46, Jesmond Avenue, Toller Lane, Bradford. Schoolmaster (Hanson Boys' Secondary School, Bradford). Inter. B.Sc. (London); first class in chemistry; advanced certificates in theoretical and practical chemistry in Board of Education examinations; seven years' teaching experience; taught Upper, Middle, and Lower Form Chemistry in large secondary school; prepared schemes of work for teaching the above; eight years' laboratory experience at Bradford Technical College and King's College, London, W. (*Signed by*) Barker North, Robt. D. Abell, T. W. Price.

HARRIS, JOHN EDMUND GUY, Bitterne House, 41, Victoria Road, Cambridge. Research chemist and bacteriologist. Research assistant to Sir Wm. J. Pope, K.B.E., University of Cambridge. B.A. (Cantab), research, 1920; B.Sc. Honours (London), 1911; A.I.C.; research chemist and bacteriologist to Messrs. Strange & Graham, Ltd., London, 1912-1914; research on pathogenic anaerobic bacteria with B E.F., 1915-1918. Author of "Contributions to the Biochemistry of Pathogenic Anaerobes," No. VIII., *Journ. Path. and Bact.*, Vol. XXIII. In conjunction with C. G. L. Wolf, B.A., M.D., author of "Contributions to the Biochemistry of Pathogenic Anaerobes," Nos. I., III., and IV., *Journ. Path. and Bact*, and *Biochem. Journ.* (*Signed by*) W. J. Pope, R. H. Vernon, J. Outram Cutter, F. W. Dootson, F. G. Mann.

HARWOOD, JOHN, 12, Cecil Street, Manchester, S.W. Assistant lecturer in chemistry, University, Manchester. B.Sc. (Hons. Chem.), Manchester; M.Sc., Manchester. (*Signed by*) H. B Dixon, Arthur Lapworth, F. P. Burt, J. E. Myers, Colin Campbell.

HAYDON, GILBERT, 2, Holland Road, Hornsey, N.8. Chemist and metallurgist. In charge of the analytical and research laboratory of S. H. Johnson & Co., Ltd., Stratford, E. (chemical engineers). Member Inst. Metals, and Associate of Inst. Aeronautical Engineers; student member Inst. Mining and Metallurgy. (*Signed by*) F. H. Lowe, J. C. Crocker, J. B. Coleman.

HAYNES, HARVEY MARSHALL, "Brynygwenyn," Ross Road, Abergavenny. Science master. Teacher of chemistry, Boys' High School, Oxford. I desire to keep in touch with the progress made in chemistry, and to receive the reports on recent researches in chemical science. (*Signed by*) T. Martin Lowry, P. C. Austin, D. L. Chapman, *Edward Hope*, *B. Lambert.*

HAYTER, STANLEY WILLIAM, 27, Birchanger Road, S. Norwood, S.E.25 Student, King's College. Employed Mond Nickel Co., York Street, Westminster. Studying for Hons. Chemistry, and wish to use library and obtain J.C.S. (*Signed by*) Samuel Smiles, Arthur Fairbourne, A. J. Allmand.

HECKER, WILLIAM RUNDLE, "Woodlands," Station Road, New Barnet, Herts. Second year's student in chemistry (Honours), University of London, King's College. (*Signed by*) Samuel Smiles, A. J. Allmand, H. W. Cremer, H. T. S. Britton, H. Toms.

HICKINBOTTOM, WILFRED JOHN, 46, Frederick Road, Stechford, Birmingham. Student of chemistry. B.Sc. (Birmingham); A.I.C. Publications: Reilly and Hickinbottom, *Trans. Chem. Soc.*, 1917, **111**, 1026; 1918, **113**, 99, 974, 985; 1919, **115**, 175; 1920, **117**, 103. *Sci. Proc. Roy. Dub. Soc.*, 1919,

15, 513; 1920, **16**, 120, 131. Reilly, Hickinbottom, Henly, and Thaysen, *Biochem. Journ.*, 1920, **14**, 229. (*Signed by*) G T. Morgan, S. R. Carter, C. E. Wood, Wm. Wardlaw, Jos. Reilly.

HOBBS, JOHN HENRY, 2, Trevarno Terrace, Tovil, Maidstone, Kent. Student. Reading for B.Sc. Hons. Chemistry at University College, London, and am desirous of keeping in touch with modern developments in chemistry. (*Signed by*) Henry Terrey, W. E. Garner, O. L. Brady, D. Ridge, A. W. R. Joachim.

HOOPER, THOMAS HAROLD, 13, Brooklands Terrace, Swansea. Student. B.Sc. (London). (*Signed by*) J. E. Coates, Leonard E. Hinkel, Ernest E. Ayling.

HOPKINS, DAVID GRAHAM, 43, Rhondda Street, Swansea. University lecturer, University College, Swansea. B.Sc. (London); A.R.C.S. (Lond.); A.I.C. 1916–1919, chemist, Messrs. Nobel's Explosives Co., Ltd.; 1919–1920, lecturer in chemistry at Swansea Technical College. (*Signed by*) Leonard E. Hinkel, Ernest E. Ayling, J. E. Coates.

HUDDART, REGINALD, 30, Blessington Road, Lee, S.E.13. Research student, University College, W.C.1. B.Sc. Hons. (chemistry 2nd class), 1920; student demonstrator in physical chemistry, University College, W.C.1. (*Signed by*) J. N. Collie, O. L. Brady, Irvine Masson.

JACOB, CEDRIC WILLIAM, Capt., late The King's Regt., 2, Beach Lawn, Waterloo, Lancs. Biscuit manufacturer; managing director, W. and R. Jacob and Co., Ltd., Aintree, Liverpool. Studied chemistry, Clifton College, Bristol; Université de Neuchâtel, Switzerland (organic chemistry); and at University of Göttingen, Germany (organic chemistry and physics); in charge of laboratories at above works during period of post-war reconstruction and prior to release of our research chemist. (*Signed by*) A. G. Francis, F. S. Thurston, J. R. Nicholls, *J. J. Fox.*

JONES, CHARLES PHILIP, 59, Voelas Street, Princes Park, Liverpool. Student of medicine at the University of Liverpool, and consultant to Abol, Ltd. Chemist in the Explosives Department, Ministry of Munitions; also chemist in Chemical Inspection Department, Ministry of Munitions; consulting chemist to Messrs. Abol, Ltd., Paddock Wood, Kent; also some research work in nicotine extraction. Reason for entering: Have decided on a medical career, but wish to keep in touch with chemical news and developments. (*Signed by*) A. Vincent Elsden, E. C. Edgar, E. Francis Smith.

KERMACK, WILLIAM OGILVY, 16, Walton Well Road, Oxford. Research chemist. M.A., B.Sc. (Aberdeen); research chemist British Dyestuffs Corporation. (*Signed by*) W. H. Perkin, G. R. Clemo, N. V. Sidgwick, P. May, Joseph Kenyon.

LAMB, HAROLD, 49, Dodworth Road, Barnsley, Yorks. Manager, Coke Oven and By-product Plant. Eight years as chemist in coke oven and by-product industry prior to appointment as manager of works. Author of paper on "The Comparative Values of Crude Benzols." (*Signed by*) C. J. Peddle, Thos. B. Smith, John W. Lee.

LEITCH, GRACE CUMMING, Bonnygate, Cupar, Fife. Lecturer in chemistry, Armstrong College, Newcastle-upon-Tyne. M.A. (St. Andrews, 1912); B.Sc. (St. Andrews, 1913); Ph.D. (St. Andrews, 1920); (1) Carnegie Research Scholar, 1914–1916; (2) Carnegie Research Fellow, 1916–1919; (3) Member of the teaching staff in chemistry in the University of St. Andrews, 1917–1920. Publications: "The Constitution of the Disaccharides, Part II.," T., 1918, **113**, 188; "The Constitution of the Disaccharides, Part III.,"

T., 1919, 115, 809 (joint author with W. N. Haworth). (*Signed by*) W. N. Haworth, P. Phillips Bedson, F. C. Garrett, J. A. Smythe.

LEVEY, ALFRED ELLIS, Horton Cottage, Market Place, Hornsea, Hull. Technical chemist. At present chief technologist, Dowdalls' Buttapat Dairies, Ltd., Hull (branch of British Oil and Cake Mills, Ltd., Hull), margarine and lard compound manufacturers; sometime chief chemist to Dowdalls' Buttapat Dairies, Ltd., Liverpool; sometime chief chemist to Messrs. Ardol, Ltd., fat hydrogenators, Selby, Yorks; sometime assistant chemist to Messrs. Loders and Nucoline, Ltd., copra crushers and vegetable butter manufacturers, London, etc., etc. (*Signed by*) Geo. H. Appleyard, E. Richards Bolton, L. Hewgill Smith.

LEVY, NATHAN LIONEL, 361, Clapham Road, Stockwell, S.W.9. Pharmacy student. Qualifying examination of the Pharmaceutical Society, Part I.; student in the Pharmacy Department, South-Western Polytechnic, Chelsea. (*Signed by*) Chas. Morton, Francis Arnall, F. H. Lowe.

LYNN, ROBERT RANKINE, 8, Windsor Quadrant, Kelvinside, Glasgow. Analytical chemist. Three years' science course, Glasgow University; one year engineering laboratories; one year in Switzerland (Zürich Polytechnicum) for technical chemistry; six months in London as chemist to J. Tylor and Sons, Ltd.; eighteen years head chemist to Babcock and Wilcox, Ltd., Renfrew, Glasgow and London; for some years have had consulting practise on my own account in Glasgow in addition to my position with Messrs. Babcock and Wilcox. (*Signed by*) W. Carrick Anderson, R. M. Clark, Douglas A. MacCallum.

MACCULLOCH, GRACE AGNES, 11, Cardwell Road, Tufnell Park, N.7. For the past three years assistant research chemist to Messrs T. Illingworth, photographic paper maker, Park Royal. London Matriculation (1st Div.), 1914; Inter. B.Sc. London, 1915; class examinations of London University up to Hons. B.Sc. (*Signed by*) F. H. Lowe, A. G. Crossley, Irvine Masson.

MCEWAN, THOMAS LAWSON, Oakfields, Brampton Road, Bexleyheath, Kent Research chemist, Research Department, Royal Arsenal, Woolwich. B.Sc. (St. Andrews); F.I.C. (Branch E); Botany, Materia Medica, King's College, London; paper works chemist; research and works chemist (acid and chemical manufacture); assistant to C. H. Cribb, Esq., B.Sc., F.I.C.; public analyst three and a-half years at Research Department, Royal Arsenal, Woolwich. (*Signed by*) Robert Robertson, Cecil H. Cribb, J. S. Dick, Reginald G. Early.

MCKENZIE, QUENTIN BRADBURY, 10, Canning Street, Launceston, Tasmania. Chemist. Course in chemistry at Launceston Technical College; two years assistant instructor; eighteen months instructor of chemistry at Launceston Technical College; three years chemist at tannery of late firm, Robt. Gardner, Ltd.; one year works manager; twelve months research works, Refractory Ores, Ltd., on electrolytic deposition of zinc and treatment of complex ores; chemist, H.M. Factory, Gretna, N.B., N/G section and acid section laboratory; chemist in charge at British Cyanides and H.M. British Potash Co., Oldbury. At present engaged on research works and commencing manufacturing (chemical) in Launceston. Member of Australian Chemical Institute. (*Signed by*) Douglas Bowack, J. C. C. Taylor, J. R. H. Bartlett, A. T. S. Sissons.

MCKEON, RALPH FREDERICK JOHN, 11, Spurstowe Road, Hackney, E.8. Science master. Formerly chemical student at Birkbeck College. At present science master under London County Council. (*Signed by*) G. W. Clough, G. H. Martin, C. Diamond.

Mamish, Ahmed Hussein, Sharia Darb El Gamamigh, Emaret Mosa Pacha No. 11, Cairo. Senior assistant chemist, Medico-Legal Laboratory, Court of Appeal, Cairo. Diploma, Government School of Pharmacy, Cairo; Sultan's prizeman, diploma examination. Two years' teaching experience, Chemical Department, School of Medicine, Cairo. (*Signed by*) C. S. Gibson, W. Morris Colles, M. Shamo Eldin, Amin Ahmad Selim.

Maude, George Williams, West View, London Road, Elworth, Sandbach, Ches. Assistant manager and chief chemist. Associate in Science of the University College, Reading (1910-1913); head assistant to Frank Higson, Esq., F.C.S., to 1919; chief chemist and assistant manager of Messrs. Hovey & Lowther, Ltd., Wheelock, Sandbach. (*Signed by*) Stanley J. Peachey, F. S. Sinnatt, F. M. Rowe.

Miles, Walter Mason, "The Gables," 176, Dykes Hall Road, Hillsbro, Sheffield. Engineering and analytical chemist to Sheffield Corporation Electric Supply Department. Assistant chemist, Newcastle Electric Supply Co., Ltd., nine years; present situation since April, 1914. During coal control:—Technical representative for Yorkshire, and later chemist for that area. Subjects taken:—Advanced organic and inorganic chemistry, oils, fats and waxes, heat, light, sound, Spanish, German, maths. Lecturing for Coal Controller on Economy; lecture on Coal to Junior Inst. of Engrs., 1916, and Boiler Feed Water Treatment, 1920 (Silver Medal); Associate of the Institution of Mechanical Engineers. (*Signed by*) Geo. H. Hodgson, G. S. Blake, John Haworth.

Mitchell, Allan Ernest, 25, Gower Street, London, W.C.1. Student. B.Sc. (chemistry and geology), Western Australia; twelve months' investigation of solar salt problems in Western Australia; at present a research worker in physical chemistry, University College, London. (*Signed by*) J. C. Ghosh, J. N. Mukherjee, W. E. Garner.

Moir, Edwin William Cecil, 10, Marlborough Road, Lewisham, London, S.E.13. Undergraduate. Educated Sidcup College under late S. Farnfield, Esq., F.R.G.S.; entered Trinity College, October, 1919, after military service in France and England, 1917-18. At present studying for Nat. Science Tripos, to be taken in June, 1921, with a view to becoming science master at a public school. (*Signed by*) Hamilton McCombie, Harold A. Scarborough, W. J. Pope.

Myers, William Lambert, 61, Prospect Avenue, Ossining, New York. Assistant director, Chilean Nitrate Committee. Graduate of Harvard, 1914, where applicant studied chemistry for three years. Degree conferred, B.A. (*Signed by*) James Kendal, William S. Myers, Thos. R. Duggan, J. Livingston R. Morgan, Marston T. Bogert.

Nakaseko, Rokuro, Muromachi-Demizu, Kyoto, Japan. Lecturer on analytical chemistry at College of Science, Kyoto Imperial University. The candidate published the following papers:—"Some Transformations of Metasulphamidobenzoic Acid under the Influence of Heat," May, 1912; "The Nucleic Acid of the Lymph Corpuscles," 1917; "The Approximate Determination of Protein in Physiological Fluids," 1918; "Laboratory Directions in Qualitative Analysis," 1918; "Laboratory Directions in Quantitative Analysis," 1920. (*Signed by*) Masumi Chikashigé, Shigeru Komatsu, Kensaku Fukuma, Kotaro Shimomura, Joji Sakurai.

Neave, Edward William James, "Burnley," Tilford Road, Farnham. Student of chemistry. Second year student in Hons. Chem., King's College, W.C.2. (*Signed by*) Samuel Smiles, A. J. Allmand, H. W. Cremer, H. T. S. Britton, H Toms.

Norris, Woodford Stanley Gowan Plucknette, "Arundel," Cliffe-at-Hoo, Kent. Student. A.R.C.S. (London). Now proceeding to the diploma of the Imperial College of Science and Technology by research in organic chemistry. Two years assistant chemist in explosives works during war. Sat for B.Sc. Honours (London), October, 1920, result not yet known. (*Signed by*) H. B. Baker, Jocelyn Thorpe, James C. Philip, H. F. Harwood, P. C. Bull.

Panderson, Olive May, 35, Dryden Street, Holderness Road, Hull, E. Yorks Works chemist. I wish to keep in touch with modern advance in chemical science and research and to make use of the library from time to time. Studied chemistry at the Hull Technical College six years. Works chemist, paint and varnish manufactury (Messrs. Raines & Porter, Ltd., Hull). (*Signed by*) Arnold R. Tankard, S. E. Neal, T. Luxton, W. C. Batty.

Phillips, Henry, 72, Ferntower Road, Canonbury, London, N.5. Research chemist at T. Illingworth & Co., Willesden Junction. I hold a B.Sc. (Hons. Chemistry), 2nd Class, and was educated at University College, University of London. I had some short experience in research on ketoximes, and am now engaged on photographic research at the above firm. (*Signed by*) A. G Crossley, F. G. Donnan, F. H. Lowe.

Player, Harold William Victor, 10, Upper Park Road, New Southgate, N.11. Student of Chemistry. Second year Hons. student, King's College, London. (*Signed by*) Samuel Smiles, A. J. Allmand, H. W. Cremer, H. T. S. Britton, S. Glasstone.

Pohl, Wilfred, "Woodville," Hockley, Essex. Post-graduate student. Having completed lecture course and obtained B.Sc. degree, I wish to keep in touch with the recent work in the chemical world. (*Signed by*) F. G. Donnan, W. E. Garner, J. N. Collie, P. C. Rây.

Polglaze, Gordon Henry Francis, Beach House, Polkerris, Par Station, Cornwall. Student in honours chemistry, King's College, London. (*Signed by*) Samuel Smiles, A. J. Allmand, H. W. Cremer, H. T. S. Britton, S. Glasstone.

Preston, Richard, 2, Islington, Liverpool. Research student (chemistry). B.Sc. (hons. chem.); Leblanc medallist, Liverpool University. (*Signed by*) Herbert H. Froysell, W. C. McC. Lewis, H. J. Cunningham.

Price, Joseph Thomas, M.B.E., 25, Clayfield Road. Scunthorpe, Lincs. Manager, Coke Oven and By-product Works for the Redbourn Hill Iron and Coal Co., Ltd., Frodingham. Twenty years student and ten years teacher of chemistry (inorganic and organic); general secretary and originator of the Coke Oven Managers' Association; member of the Ammonia Advisory Committee, Ministry of Munitions; trained at Cardiff University College; sometime consulting chemist to the Automobile Association and Motor Union; consulting chemist to several collieries; joint editor of the *Coke Oven Managers' Year-book*, etc., etc. (*Signed by*) Thomas Crowdy, G. R. Doyle, Ernest M. Myers, *J. P. Longstaff, R. John Sudlow.*

Puri, Vidya Sagar, c/o Messrs. Stirling Mason and Co., 114, Fenchurch Street, London, E.C.3. Carrying on research work in chemistry in King's College, London. Master of Science of the Punjab University, and formerly demonstrator in physics, D. S. College, Lahore; have also done some work on the estimation of chlorides. (*Signed by*) A. J. Allmand, Arthur Fairbourne, Samuel Smiles, S. Glasstone, H. W. Cremer.

Pyne, Herbert Rivington, Peajack, N.J., U.S.A. Instructor of physical chemistry at Princeton University. Received degree of A.M. from Columbia

University for chemical work; at present studying for Ph.D. degree; lecturing on physical chemistry at Princeton University. (*Signed by*) Alan W. C. Menzies, J. Livingston R. Morgan, Marston T. Bogert.

QUICK, WILLIAM CLIFFORD, 13, Brighton Road, Weston-super-Mare. Studying for the degree of B.Sc. Bristol in physics and chemistry (hons. chem.). Matriculated in Bristol University, October, 1919, and passed the intermediate examination for the degree of B.Sc., June, 1920; at present engaged in first year course for final B.Sc. (*Signed by*) J. W. McBain, F. Francis, W. Taylor, F. W. Rixon, M. Nierenstein.

RAVALD, LEONARD ALLAN, c/o All Saints' Vicarage, Leyton, E.10. Research chemist. Student, University of Manchester, 1912–15; took degree of B.Sc. (Tech.) in applied chemistry. Student, University of Manchester, College of Technology, 1919–20; presented thesis for degree of M.Sc. (Tech.). Appointed research chemist, Gas, Light and Coke Co., October, 1920. (*Signed by*) Frank Lee Pyman, Edmund Knecht, F. M. Rowe.

ROBSON, WILLIAM, East Cramlington, Cramlington, Northumberland. Demonstrator in chemistry, the University, Edinburgh. B.Sc. (hons.) London; engaged in research under Professor Barger. (*Signed by*) A. J. Allmand, Samuel Smiles, John E. Mackenzie, James Walker, George Barger.

ROBERTS, HAROLD, 58, Smedley Road, Cheetham, Manchester. Schoolmaster. Since 1912 have been engaged in teaching elementary science in a Manchester school (break, 1914–1919, Army service), and in 1921 was appointed to the post of junior science (chemistry and mathematics) master in the Herbert Strutt Secondary School; 1919–; have been a student at the Manchester School of Technology, taking chemistry with a view to completing my degree (B.Sc. London), as I already hold the Inter. B.Sc. London. (*Signed by*) Frank Lee Pyman, F. S. Sinnatt, G. D. Elsdon.

ROLT, WILLIAM JOSEPH WOODGATE, 5, Honley Road, Catford, S.E.6. Research student, University College, London; sat for B.Sc. hons. this year. (*Signed by*) O. L. Brady, J. N. Collie, F. G. Donnan.

ROWE, ALLAN WINTER, S.B., S.M., A.M., Ph.D., 295, Commonwealth Avenue, Boston, Mass., U.S.A. Professor of chemistry, Boston University School of Medicine; research associate in chemistry, Evans Memorial Hospital. *Physical Review*, 19–330, 1904 (with W. P. Bradley); *Zeitschrift für Physik. Chemie*, 1906; series of papers in thermo-chemistry with T. W. Richards, *Proc. Am. Acad.*, *Zeit. Physik. Chem.*, and *J. Amer. Chem. Soc.* (*Signed by*) Wm. Goodwin, H. B. Hutchinson, B. Lambert.

ROWLEY, ERNEST WHITWORTH, 17A, Pierremont Crescent, Darlington. Analytical and consulting chemist. Chief analytical and consulting chemist to the North-Eastern Railway Co. (*Signed by*) Harold Gripper, L. Archbutt, C. H. Ridsdale, H. Frankland, N. D. Ridsdale, J. T. Dunn.

SAKO, SHINICHI, 36, Flanchford Road, Stamford Brook, W.12. Assistant professor, Kinshu Imperial University, Japan. Graduate of the Science College of Tohoku Imperial University; Japanese Government scholar; at present doing research work in organic chemistry at the Imperial College of Science and Technology, London. (*Signed by*) Jocelyn Thorpe, C. K. Ingold, J. P. C. Chandrasena.

SALMON, CYRIL SEBASTIAN, 112, Regents Park Road, N.W.1. Lecturer in physical chemistry, King's College, London. M.Sc. (Bristol); three years' research experience. (1) "Colloidal Electrolytes" (*Proc. Roy. Soc.*); (2) "Sodium Ions in Soap Solution" (*Trans. Chem. Soc.*). (*Signed by*) Arthur Fairbourne, H. W. Cremer, Harold Toms.

SEAL, LEONARD, Bank Chambers, 1, Town Hall Square, Bradford. Metallurgical, analytical, and consulting chemist. Final examination in metal-

lurgy, University of Sheffield; assistant to an analytical and metallurgical chemist; manager at a chemical works; assistant to a public and county analyst. Research on manufacture of sodium sulphate and sulphite from by-product from phenol manufacture; research on extraction of bismuth from copper ore; research on a detinning process. (*Signed by*) Geoffrey E. Foxwell, A. Forster, R. Gawler, *A. E. Findley*, *W. E. S. Turner*.

SEN, NAGENDRA NATH, 37, Anthony Bagan Lane, Calcutta, India. Analytical and consulting chemist. B.Sc. of the Calcutta University with honours in chemistry, 1914; M.Sc. of the Calcutta University in chemistry, 1916; for three years research scholar, College of Science, University of Calcutta. Joint author of an original paper published in the *Journal of the Chemical Society* (T., 1919, 115, 461); author of another paper, "Interaction of Phosphorous Haloids and Arsenious and Arsenic Compounds," *Journal of the Asiatic Society*, Bengal. For fourteen months in the employ of Messrs. J. and R. Hutchison, consulting and analytical chemists and metallurgists, 1 and 2, Hare Street, Calcutta. (*Signed by*) P. C. Rây, J. B. Bhaduri, R. H. Turnbull.

SIMS, LIONEL GEORGE ALWYNE, 113, Blackpool Street, Burton-on-Trent. Student. Member and undergraduate of University of Birmingham: degree student in Faculty of Science; keen enthusiast in all matters chemical; I am particularly desirous of entry into Chemical Society to obtain latest information in progress of chemical science and to obtain privilege of access to Society's library—a great boon. (*Signed by*) G. T. Morgan, S. R. Carter, Wm. Wardlaw.

SQUANCE, WILLIAM ALFRED, Hill, Shebbear, near Highampton, N. Devon. Student. Three years studying for B.Sc. hons. (Bristol). (*Signed by*) M. Taylor, J. W. McBain, F. Francis, F. W. Rixon, M. Nierenstein.

STEPHENSON, MARJORY, Romsey House, Cambridge. Biochemical research. Beit Memorial research fellow. "On the Nature of Animal Lactase," *Biochem. J.*, 1912, **6**, 250; "Some Esters of Palmitic Acid," *Biochem. J.*, 1913, **7**, 429; "A Study of the Metabolism in Experimental Diabetes" (in collaboration), *Biochem. J.*, 1915, **9**, 171; "A Contribution to the Study of Keratomalacia among Rats" (in collaboration), *Biochem. J.*, 1920, **14**, 502; "A Note on the Differentiation of the Yellow Plant Pigments and the Fat-Soluble Vitamine," *Biochem. J.*, 1920, **14** (in the press). (*Signed by*) F. G. Hopkins, Arthur Harden, R. H. A. Plimmer.

STEWART, JOHN WELSH, 6, Bank Street, Hillhead, Glasgow, W. Metallurgical chemist. Chief assistant chemist, Messrs. David Colville and Sons, Motherwell; teacher of metallurgy and metallurgical chemistry in technical classes of Dalziel High School, Motherwell. (*Signed by*) David J. Pinkerton, John Wm. Biggart, William Love Biggart.

STEWART, LACHLAN MACQUARIE, c/o Hiett, 89, Ryland Road, Edgbaston, Birmingham. Assistant lecturer on chemistry at Birmingham University. Degrees: M.A., B.Sc. (pure science), B.Sc. (agriculture); three years' experience in teaching; two years' experience in analytical chemistry in works. (*Signed by*) T. L. Lockhart, Wm. Wardlaw, A. E. Goddard, C. E. Wood, S. A. Pearman.

STREATFEILD, ROBERT CORNTHWAITE, Queens' House, 49, Rotherhithe Street, S.E.16. Analytical chemist. Demonstrator in physics and chemistry, Trent College, January, 1913, to August, 1914; assistant analytical chemist to British Oil and Cake Mills, Copenhagen Place, Limehouse, May, 1919, to present date; September, 1914, to January, 1919, officer (Captain) in H.M. Forces. (*Signed by*) A. B. Shepherd, W. B. Tuck, B. R. Heasman.

SUTHERLAND, MARGARET MILLEN JEFFS, St. Margarets, Lenzie, near Glas-

gow. Lecturer in chemistry. D.Sc. (Glasgow); Fellow of the Institute of Chemistry. Several publications in the *Journal of the Chemical Society.* Lecturer and demonstrator in chemistry in the Royal Technical College, Glasgow, since 1913. (*Signed by*) F. J. Wilson, R. M. Caven, Thomas Gray.

TAYLOR, ALBERT, 17, Cartwright Street, Hooley Hill, near Manchester. Assistant lecturer in chemistry, Royal Technical Institute, Salford; B.Sc., Victoria University, Manchester (2nd class honours). (*Signed by*) B. Prentice, E. Clark, V. Edge, Henry Stephen, J. E. Myers.

TAYLOR, THOMAS WESTON JOHNS, Brasenose College, Oxford. Fellow of Brasenose College. 1st class honours, School of Natural Science (Chemistry), Oxford, June, 1920; appointed lecturer in chemistry of Brasenose College, July, 1920; demonstrator at the Dysons Perrin Laboratory of Organic Chemistry, October, 1920. (*Signed by*) W. H. Perkin, Edward Hope, N. V. Sidgwick, D. Ll. Hammick, B. Lambert.

THIERRY, EDWARD HENRY, 27, Madeley Road, Ealing, W.5. Student. B.Sc. (hons.) London; student at University College, Gower Street. (*Signed by*) O. L. Brady, F. G. Donnan, H. Buckley.

TOTIENBERG, CHARLES REUBEN, 20, Green Dragon Place, Aldgate, E.C.1. Analytical chemist. Three years' practical chemistry at Sir John Cass Technical Institute; qualifying examination of Pharm. Society; three years' experience in analytical laboratory; one and a-half years' experience in manufacturing laboratory of wholesale and manufacturing chemists; one and a-half years' practical chemistry at South-Western Polytechnic. (*Signed by*) J. B. Coleman, H. Bogdanor, J. C. Crocker.

TURNER, FREDERICK WILLIAM, 12, Parthenia Road, Walham Green, London, S.W.6. Research student. Post-graduate research student at East London College; B.Sc. (first class honours in chemistry) of London University, 1920. (*Signed by*) F. G. Pope, J. R. Partington, M. O. Forster.

WALKER, JAMES, Garnock, All Saints' Road, Gloucester. Student of chemistry. Second year student in honours chemistry, King's College, London University. (*Signed by*) A. J. Allmand, H. W. Cremer, H. T. S. Britton, H. Toms, S. Smiles.

WALKER, WILLIAM CAMERON, 24, Coleridge Place, Bradford. Student at University of London, King's College. Passed Inter. B.Sc. (Lond.), and in training for the honours degree in chemistry. (*Signed by*) Samuel Smiles, A. J. Allmand, H. W. Cremer.

WILKINSON, JOHN FREDERICK, "Holmwood," Davenport Park, Stockport. Research graduate (Manchester University) B.Sc., 1st class Hons. (Vic. Univ., Manchester); graduate scholar (1920). (*Signed by*) H. B. Dixon, Henry Stephen, William J. Jones.

WOOD, CYRIL CHRISTIAN, 94, Park Avenue South, N.8. Demonstrator, St. Thomas's Hospital Medical School, S.E.1. Paper published in the *Analyst* on "A New Method for the Estimation of Methyl Alcohol," by S. B. Schryver and myself. Four years at the Royal College of Science; 1st class A.R.C.S. (*Signed by*) H. R. Le Sueur, James C. Philip, Jocelyn Thorpe, H. B. Baker.

Certificates have been accepted by the Council under Bye-Law I (2) in favour of the following:

GYTON, WALTER JAMES, P.O. Box 699, Bulawayo, S. Rhodesia. Works chemist to Premier Portland Cement Co., Ltd., Bulawayo. Trained at Univ. Coll., Southampton, and with Dr. Scott Tebb and Dr. J. Muter, public

analysts. Formerly works chemist to Messrs. Martin Earle & Co., and British Standard Cement Co., cement manufacturers. (*Signed by*) W. Gasson.

HAWLEY, HERBERT VERNON, 60, Yamashitacho, Yokohama, Japan. Managing director of company for manufacturing chemicals and conducting analyses. Life member of Pharmaceutical Society of Great Britain. Investigations, as natural outcome of twenty-five years in present profession. Official analyst to H.B.M.'s Consulate-General; to U.S.A. Consulate-General, and Netherlands Consulate at Yokohama. In the course of my profession have analysed over 6,000 specimens during past five years (oils, minerals, chemicals, dyes, foods, etc., etc.). (*Signed by*) Wm. H. Saunders, *Charles Huxtable, A. C. Abraham, James Hy. Allan, William Kirkby, F. M. Rowe, John K. Wood, H. Humphreys Jones.*

MINOVICI, PROFESSOR DR. STEFAN, 32, Bulevardul Carol, Bucuresti Roumania). Director of the Chemical Laboratory, University of Bucarest. Secretary to the Roumanian Chemical Society. (*Signed by*) Jules Cofman-Nicoresti.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, February 3rd, 1921, at 8 p.m., SIR JAMES J. DOBBIE, D.Sc., F.R.S., President, in the Chair.

The PRESIDENT referred to the great loss the Society had sustained through the sudden death, on Monday, January 31st, of Dr. J. C. Cain, Editor of the Society's *Journal.* He emphasised the efficiency and loyalty of Dr. Cain's services to the Society, and on behalf of the Fellows expressed the warmest sympathy with the widow and family of the deceased.

J. H. Foulger, S. Back, A. G. Milligan, L. H. Trace, and S. L. Litchfield were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

Gerald Morris Abrey, Tudor Lodge, Bath Road, Slough.
Stanley Francis Birch, B.Sc., 28, Marloes Road, Kensington, W.8
Frederick Stanley Winston Brice, 46, Hamilton Road, Felixstowe.
Mary Sumner Crewdson, B.Sc., 50, Southwood Lane, Highgate, N.6
Harry FitzGibbon Dean, M.Sc., 57, Ashley Road, Bristol.
Charles Ottley Ellison, Elmfield, Headingley, Leeds.
John Greenham, Bedford, Halifax, Nova Scotia.
Thomas Henry Johnson, 16, Framfield Road, Highbury, N.5
Eric Millward Joiner, 17, Lozells Street, Birmingham.
Ernest David Kitchen, 50, Edensor Road, Keighley.
George Lawton, B.Sc., 3, Eldroth Road, Savile Park, Halifax.
Clifford George Pope, 18, Cowper Street, Redfield, Bristol.
Edgar Rhodes, Cross House, East Brierley, Bradford.

Elwyn Roberts, B.Sc., 3, Mostyn Terrace, Bethesda, Bangor.
Jrivan Lal Sarin, M.Sc., Batala, Punjab, India.
Percy Harry Smith, B.Sc., 24, Hamilton Road, Ilford.
Charles William Spiers, M.Sc., 20, Florence Park, Redlands, Bristol.
Harold Stevenson, 6, Cranbourne Road, Heaton Moor, Stockport.
Frederic James Stoakley, Chemical Laboratory, The University, Cambridge
Leonard Moore Stockdale, Station House, Cullingworth, Bradford.
Edward Joseph Weeks, 62, Forest Hill Road, East Dulwich, S.E 22.
Hugh Robinson Whitehead, 3, Ebor Place, Hyde Park, Leeds.
Rowland Marcus Woodman, 72, Ladypit Lane, Beeston Hill, Leeds
Arthur Wormall, 20, Ashville View, Cardigan Road, Leeds.

The meeting was then adjourned, and the Informal Meeting declared open. During the evening Dr. W. E. S. Turner gave a demonstration of certain features of the production of optical and chemical glass.

Ordinary Scientific Meeting, Thursday, February 17th, 1921, at 8 p.m., Sir James J. Dobbie, D.Sc., F.R.S., President, in the Chair.

The President announced that the Society had lost, through death, the following Fellows:

	Elected.	Died.
William Herbert Pike	Jan. 15th, 1874	Feb. 8th, 1921
Kunjo Behary Seal	Dec. 5th, 1912	

A. Browne, M. C. Soar, L. A. Rumble, and S. S Deshapande were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

John Henry Anderson, Botany Cottage, Purfleet.
Arthur George Bell, Hazel House, Dovecot Street, Stockton-on-Tees.
Mary Boyle, D.Sc., Royal Holloway College, Englefield Green, Surrey.
Ernest Augustus Dancaster, B.Sc., A.I.C., 101, Merton Hall Road Wimbledon, S.W.19.
Percy Edwards, 12, Parkfield Road, New Moston, Manchester.
George Straton Ferrier, 10, Hamilton Park Terrace. Hillhead, Glasgow.
Victor Eric Fry, Royal Hotel, Glasgow.
William Henry Hawkes, 42, Great Sutton Street, Goswell Road, E.C.1.
Reginald William Jenkes, 17, Braydon Road, Stamford Hill, N.16.
Jogendra Nath Maitra, B.Sc., 58A, Colootola Street, Calcutta, India.
John Davenport Newall Molesworth, Balcombe, Sussex.
Donald George Murdock, B.Sc., 26, Olive Road, Cricklewood, N.W.2
Colonel Sir Frederick Lewis Nathan, K.B.E., 37, Cornwall Gardens, S.W.7.
George Charles Pawley, Crampton Street School, Newington Butts, S.E.17.

Edith Hilda Pawsey, B.Sc., A.I.C., 4, Parade Mansions, Coldharbour Lane, Camberwell, S.E.5.

Hans Thorning Baggesgaard Rasmüssen, University Chemical Laboratory, 5, Østervoldgade, Copenhagen K, Denmark.

Cecil William Rogers, B.Sc., Roding Villa, Maybank Road, South Woodford.

Harold Silverberg, B.Sc., 187, Victoria Park Road, South Hackney, E.9.

Willie Sowden, B.Sc., 48, High Street, Cleckheaton.

May Williams, B.Sc., 6, Ruskin Close, Meadway, N.W.11.

A certificate has been authorised by the Council for presentation to ballot under Bye-Law I. (2) in favour of:

William Torrance, Grootfontein Agricultural College, Middelburg, Cape Province, S. Africa.

Dr. P. C. Austin and Mr. E. R. Thomas were elected Scrutators, and a ballot for the election of Fellows was held. The following were subsequently declared elected as Fellows:

Eric Newmarch Allott, B.A.
Charles Frederick Allpress, B.Sc., A.I.C.
Henry Reason Ambler, B.Sc.
Harry George Belasco, B.Sc.
Kau Shal Kishore Bhargava, M.Sc.
Reginald Robert Bird, B.Sc., A.I.C.
Frederick Blevins.
Benjamin Talbott Brooks, B.A., Ph.D.
Henry Burgess, B.Sc.
Harold Burton, B.Sc.
Joseph Michael Carrick
Eileen Mary Chatt, B.Sc., A.I.C.
Cecil Harry Chester.
Thomas Clarke.
Francis Herbert Clews, M.Sc.
Percival Walter Clutterbuck.
James Wilfred Cook, B.Sc.
Albert Edward Cox.
George Andrew Dalrymple.
Jaroslav Dědek, D.Chem.
Joseph Neatby Doughty, B.Sc.
Arthur Henry Ford-Moore.
Thomas Francis.
Reginald George Franklin.
William Alfred Godby
Walter James Gyton.
Harry Halls.
John Edmund Guy Harris, B.A., B.Sc., A.I.C.
John Harwood, M.Sc.
Herbert Vernon Hawley.
Gilbert Haydon.
Harvey Marshall Haynes.
Stanley William Hayter.
William Rundle Hecker.
Wilfred John Hickinbottom, B.Sc., A.I.C.
John Henry Hobbs.
Thomas Harold Hooper, B.Sc.
David Graham Hopkins, B.Sc., A.I.C.
Reginald Huddart, B.Sc.
Cedric William Jacob.
Charles Philip Jones.
William Ogilvy Kermack, M.A., B.Sc.
Harold Lamb.
Grace Cumming Leitch, M.A., B.Sc., Ph.D.
Alfred Ellis Levey.
Nathan Lionel Levy.
Robert Rankine Lynn.
Grace Agnes Macculloch.
Thomas Lawson McEwan, B.Sc., F.I.C.
Quentin Bradbury McKenzie.
Ralph Frederick John McKeon.
Ahmed Hussein Mamish.
George Williams Maude.
Walter Mason Miles.
Stefan Minovici.
Allan Ernest Mitchell, B.Sc.

Edwin William Cecil Moir.
William Lambert Myers, B.A.
Rokuro Nakaseko.
Edward William James Neave.
Woodford Stanley Gowan Plucknette Norris.
Olive May Panderson.
Henry Phillips, B.Sc.
Harold William Victor Player.
Wilfred Pohl, B.Sc.
Gordon Henry Francis Polglaze
Richard Preston, B.Sc.
Joseph Thomas Price
Vidya Sagar Puri, M.Sc.
Herbert Rivington Pyne, A.M
William Clifford Quick.
Leonard Allan Ravald, B.Sc
Harold Roberts
William Robson, B.Sc.
William Joseph Woodgate Rolt
Allan Winter Rowe, S.B., S.M., A.M., Ph.D.
Ernest Whitworth Rowley.
Shinichi Sako.
Cyril Sebastian Salmon, M.Sc.
Leonard Seal.
Nagendra Nath Sen, M.Sc.
Lionel George Alwyne Sims.
William Alfred Squance.
Marjory Stephenson.
John Welsh Stewart.
Lachlan Macquarie Stewart, M.A., B.Sc.
Robert Cornthwaite Streatfeild.
Margaret Millen Jeffs Sutherland, D.Sc., F.I.C.
Albert Taylor, B.Sc.
Thomas Weston Johns Taylor B.A.
Edward Henry Thierry, B.Sc.
Charles Reuben Tottenberg.
Frederick William Turner, B.Sc.
James Walker.
William Cameron Walker.
John Frederick Wilkinson, B.Sc.
Cyril Christian Wood.

The following papers were read:

"Equilibria of hydrofluosilicic acid." By L. J. Hudleston and H. Bassett.

"The structural isomerism of oximes. Part I. Criticism of the Hantzsch-Werner hypothesis of the geometrical isomerism of carbon–nitrogen compounds." By F. W. Atack.

"The structural isomerism of oximes. Part II. Constitution of oximes." By F. W. Atack.

"The system picric acid–phenyl acridine." By H. Bassett and T. A. Simmons.

"On interfacial tension. Part I. The statical measurement of interfacial tension in absolute units." By W. C. Reynolds.

"On interfacial tension. Part II. The relation between interfacial and surface tension in sundry organic solvents in contact with aqueous solutions." By W. C. Reynolds.

ANNOUNCEMENTS.

With the approval of the Union Internationale de la Chimie Pure et Appliquée, the Council has decided to publish the list of Physico-Chemical Symbols drawn up by a Committee of the International Association of Chemical Societies.

2. The following letter sent by the Board of Trade to the Institute of Chemistry and communicated to the Chemical Society may be of interest to Fellows:

SIR

With further reference to your letter of the 28th January regarding the Dyestuffs (Import Regulation) Act, 1920, I am directed by the Board of Trade to state that, whilst it is not possible to regard small quantities of organic intermediate products which may be required for research purposes as being outside the scope of the Act, the Board will be prepared to issue general licenses for the importation of such products to approved research institutions covering periods of three months and limited only as to total quantities. This procedure will obviate the necessity for separate applications for a large number of small items, but it will be a condition of the issue of any general license that a detailed return shall be furnished at the end of the three months during which the license is in operation, of the quantities of each product actually imported under it.

I am, Sir,
Your obedient Servant,
(Signed) PERCY ASHLEY.

3. The Council has decided to award the Longstaff Medal to Professor J. F. Thorpe, and the presentation will be made at the Annual General Meeting on March 17th.

ANNIVERSARY DINNER.

The Anniversary Dinner will be held at the Hotel Cecil, Strand March 17th at 7 for 7.30 p.m., the day of the Annual General Meeting. The presence of ladies as guests of Fellows will be welcomed.

Tickets, price 14/- each, can be obtained from the Assistant Secretary, to whom application should be made as soon as possible.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

BUJARD, ALFONS, and BAIER, EDUARD. Hilfsbuch für Nahrungsmittelchemiker zum Gebrauch im Laboratorium für die Arbeiten der Nahrungsmittelkontrolle gerichtlichen Chemie und anderen Zweige der öffentlichen Chemie. 4th edition. Berlin 1920. pp. xx + 884. ill. (*Recd.* 22/1/21.)

From the Publisher: Julius Springer.

EVANS, ELLIOTT ALFRED. Lubricating and allied oils: a handbook for chemists, engineers and students. London 1921. pp. xvi + 128. ill. 9*s*. 6*d*. net. (*Recd.* 22/1/21.)

From the Publishers: Messrs. Chapman and Hall.

GERHARDT, CHARLES. Correspondance. Vol. I. Laurent et Gerhardt: 1844—1852. Edited by MARC TIFFENEAU. Paris 1918. pp. xxxii + 366. ill. (*Recd.* 20/12/20.)

From the Publishers: Masson et Cie.

LEWIS, ERNEST ISAAC. Inorganic chemistry [3rd edition.] Cambridge 1920. pp. xvi + 443. ill. 9*s*. net. (*Recd.* 31/1/21.)

From the Publishers: Cambridge University Press.

II. *By Purchase.*

CAVEN, ROBERT MARTIN. The foundations of chemical theory: an introductory textbook. London 1920. pp. viii + 266. ill. 12*s*. 6*d*. net. (*Recd.* 21/1/21.)

DIETERICH, KARL. The analysis of resins, balsams and gum resins. With a bibliography. 2nd English edition. Translated by HERBERT BIRTWHISTLE STOCKS. London 1920. pp. xvi + 431. 17*s*. 6*d*. net. (*Recd.* 16/11/20.)

EULER, HANS. Chemie der Enzyme. I. Allgemeine Chemie der Enzyme. 2nd edition. München 1920. pp. xii + 308. ill. (*Recd.* 31/1/21.)

FREUDENBERG, KARL. Die Chemie der natürlichen Gerbstoffe. Berlin 1920. pp. viii + 161. (*Recd.* 8/2/21.)

GEORGIEVICS, GEORGE VON. Die Beziehungen zwischen Farbe und Konstitution bei Farbstoffen. Zürich 1921. pp. viii + 123. (*Recd.* 8/2/21.)

HAUSBRAND, EUGEN. Das Trocknen mit Luft und Dampf: Erklärungen, Formeln und Tabellen für den praktischen Gebrauch. 5th edition. Berlin 1920. pp. viii + 185. ill. (*Recd.* 31/1/21.)

KÖNIG, J. Chemie der menschlichen Nahrungs- und Genussmittel. Supplement to Vol. I. Edited by J. GROSSFELD, A. SPLITTGERBER and W. SUTHOFF. Berlin 1919. pp. viii + 594. (*Reference.*)

LEHMANN, KARL BERNHARD, and NEUMANN, RUDOLF OTTO. Atlas und Grundriss der Bakteriologie und Lehrbuch der speziellen bakteriologischen Diagnostik. 6th edition. 2 vols. München 1919—1920. 79 plates, pp. xvi + 847. ill. (*Recd.* 19/1/21.)

OSTWALD, WOLFGANG, and WOLSKI, PAUL. Kleines Praktikum der Kolloidchemie. Dresden 1920. pp. xii + 159. ill. (*Recd.* 31/1/21.)

PLOTNIKOW, JOHANNES. Allgemeine Photochemie: ein Hand- und Lehrbuch für Forschung, Praxis und Studium. Berlin 1920. pp. xiv + 729. ill. (*Recd.* 8/2/21.)

RISTENPART, E. Chemische Technologie der organischen Farbstoffe. Leipzig 1911. pp. xii + 122. [56 pattern sheets.] ill. (*Reference.*)

TRUTTWIN, HANS. Enzyklopädie der Küpenfarbstoffe: ihre Literatur, Darstellungsweisen, Zusammensetzung, Eigenschaften in Substanz und auf der Faser. Berlin 1920. pp. xx + 868. (*Recd.* 19/1/21.)

WHITEHEAD, SIDNEY EDWARD. Benzol: its recovery, rectification and uses. London 1920. pp. xiv + 209. ill. 12*s*. 6*d*. net. (*Recd.* 21/1/21.)

III. *Pamphlets.*

IMPERIAL MINERAL RESOURCES BUREAU. The Mineral Industry of the British Empire and Foreign Countries. War Period Bismuth. (1913—1919.) London 1920. pp. 14.

— — Asbestos. (1913—1919.) London 1921. pp. 34.

INTERNATIONAL ELECTROTECHNICAL COMMISSION. International symbols. Part I. Letter symbols. Revised edition. London 1920. pp. 16.

MOIR, JAMES. Colour and chemical constitution. Part X. A general numerical solution of the colour-constitution problem. (From the *Trans. Roy. Soc. S. Africa*, 1920, **8**.)

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, March 3rd, 1921, at 8 p.m., SIR JAMES J. DOBBIE, D.Sc., F.R.S., President, in the Chair.

The PRESIDENT announced that the Society had lost, through death, the following Fellows:

	Elected.	Died.
William Odling	Jan. 17th, 1848.	Feb. 17th, 1921.
George Alexander Byrn	Dec. 6th, 1888.	Jan. 2nd, 1921.
Thomas Fogg	June 16th, 1859.	Feb. 24th, 1921.

The list of nominations for vacancies on the Council was read from the Chair.

E. M. Chatt, H. R. Ambler, H. Phillips, R. C. Streatfeild, F. M. Wood, H. G. Belasco, W. S. Norris, G. A. Macculloch, and R. F. J. McKeon were formally admitted as Fellows of the Chemical Society.

Dr. J. Kenyon and Dr. J. I. O. Masson were appointed Scrutators to assist in the counting of votes recorded in the election of the Council.

Certificates were read for the first time in favour of:

Hridi Ranjan Das, M.Sc., Canning College, Lucknow, India.
Archibald Arthur Davis, 1, King's Road, Henley-on-Thames.
Edward Lionel Dawson, 28, Norrey's Street, Rochdale.
Charles William Everett, 3, Compton Street, Brunswick Square, W.C.1.
David Templeton Gibson, B.Sc., Altamont, Bangor, Co. Down.
Alfred Norman Harris, Bramley, Haugh Road, Walmer, Port Elizabeth, S. Africa.

Douglas Frank Harrison, 19, Woburn Square, W.C.1.
Robert William Kinkead, B.Sc., Hollymount, Osborne Park, Belfast.
Basil Charles McEwen, B.Sc., H.E.H. The Nizam's College, Hyderabad, Deccan, India.
Henry Brown Mackie, 5, Balfour Road, Brighton.
John Mandell, 12, Campden Hill Gardens, Kensington, W 8.
Maneck Merwanji Mehta, M.A., M.Sc., 116, Grosvenor Road, Highbury, N.5.
Leslie Burt Milne, 27, Warren Road, Wanstead, E.11.
John Trengove Nance, M.A., 9, Green Bank Drive, Sefton Park, Liverpool.
John Guy Porter, St Mary's Street, Ely.
William John Read, M.Sc., F.I.C., 71, Northgate, Wakefield.
Harold Edmund Robinson, 146, Platt Lane, Rusholme, Manchester.
John Richard Scott, 12, Roundhay Crescent, Harehills Lane, Leeds.
Percy Archibald Sporing, B.Sc., 78, Warren Street, Fitzroy Square, W.1.
John Frederic Ward, 50, Elgin Crescent, W.11.

A certificate has been authorised by the Council for presentation to ballot under Bye-Law I (2) in favour of:

Dinanath Talwar, Dayal Bagh, Agra, U.P., India.

The following papers were read:

"The chemistry of the glutaconic acids. Part XII. The simultaneous occurrence of 1:2- and of 1:3-addition to glutaconic ester. A study in mobile equilibrium involving the utilisation of the labile ester in the 'nascent' condition." By C. K. Ingold and J. F. Thorpe.

"A second form of 6:6′-dinitrodiphenic acid and its conversion into new cyclic systems." By J. Kenner and W. V. Stubbings.

"The structural isomerism of oximes. Part III. A fourth benzildioxime." By F. W. Atack and L. Whinyates.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Audley, James Aloysius. Silica and the silicates. London 1921. pp. xiv + 374. ill. 15*s*. net. (*Recd.* 2/3/21.)

From the Author.

Baker, Richard T., and Smith, Henry George. A research on the eucalypts, especially in regard to their essential oils. 2nd edi-

tion. Sydney 1920. pp. xvi + 470. ill. 42*s*. net. (*Recd.* 17/2/21.) From the Authors.

BARNETT, EDWARD DE BARRY. Anthracene and anthraquinone. London 1921. pp. xii + 436. ill. (*Reference.*) 27*s*. 6*d*. net. From the Publishers: Messrs. Baillière, Tindall and Cox.

BARRETT, ERNEST. A second class-book of chemistry. London 1920. pp. viii + 272. ill. 6*s*. net. (*Recd.* 17/2/21.) From the Publishers: Messrs. A. and C. Black.

BUREAU DES LONGITUDES. Annuaire pour l'an 1921. Paris [1921]. pp. viii + 710 + 42 + 18 + 69. ill. (*Reference.*) 8 fr. From the Publishers: MM. Gauthier-Villars et Cie.

FIERZ-DAVID, HANS EDUARD. The fundamental processes of dye-chemistry. Translated by FREDERICK ALFRED MASON. London 1921. pp. xiv + 240. ill. 21*s*. net. (*Recd.* 24/2/21.) From Dr. M. O. Forster.

RUSSELL, T. H. The planning and fitting-up of chemical and physical laboratories. London 1903. pp. xx + 178. ill. (*Recd.* 16/2/21.) From Mrs. Cain.

STURTEVANT ENGINEERING CO., LTD. Modern manufacture of chemical manures. London 1920. pp. 85. ill. (*Recd.* 7/3/21.) From the Sturtevant Engineering Co.

II. *By Purchase.*

CLASSEN, ALEXANDER. Handbuch der analytischen Chemie. II. Quantitative Analyse. 7th edition. Stuttgart 1920. pp. viii + 580. ill. (*Recd.* 14/2/21.)

GUNTHER, R. T. Early science in Oxford. Part I. Chemistry. Oxford 1920. pp. vi + 91. ill. 6*s*. net. (*Recd.* 21/1/21.)

HOFMANN, KARL ANDREAS. Lehrbuch der anorganischen Chemie. 3rd edition. Braunschweig 1920. pp. xx + 744. ill. (*Recd.* 14/2/21.)

LANGE, OTTO. Die Zwischenprodukte der Teerfarbenfabrikation: ein Tabellenwerk für den praktischen Gebrauch. Nach der Patentliteratur. Leipzig 1920. pp. xxiv + 645. (*Recd.* 19/2/21.)

THORPE, SIR EDWARD. A dictionary of applied chemistry. I. A—Calcium. Revised edition. London 1921. pp. x + 752. ill. (*Reference.*) 60*s*. net.

III. *Pamphlets.*

BROOKS, S. C. Precise titration of complement. (From the *J. Med. Res.*, 1920, **41**.)

—— The regeneration of complement after radiation or heating. (From the *J. Med. Res.*, 1920, **41**.)

IMPERIAL MINERAL RESOURCES BUREAU. The Mineral Industry of the British Empire and Foreign Countries. War Period. Antimony. (1913—1919.) London 1921. pp. 34.

—— —— Cobalt. (1913—1919.) London 1921. pp. 22.

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE. Report . . . and proceedings of the Science Convention, 1918. Calcutta 1920. pp. iv + 200 + xxxi. ill.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND. Lecture on some scientific aspects of tanning. By JOSEPH TURNEY WOOD. London 1920 pp. 30. ill.

MANLEY, J. J. On the use of highly-attenuated wires for platinum thermometers. (From the *Register Daubeny Lab.*) 1919.

PUSA, AGRICULTURAL RESEARCH INSTITUTE. *Indigo Publication No.* 7. The conditions affecting the quality of the Java indigo plant (leaf yield and richness of the leaf in indigotin). By WILLIAM ALFRED DAVIS. Calcutta 1920. pp. ii + 33.

REINITZER, FRIEDRICH. Die Gerbstoffbegriff und seine Beziehungen zur Pflanzenchemie. (From *Lotos*, 1891, N.F. **11**.)

—— Ueber die Eignung der Huminsubstanzen zur Ernährung von Pilzen. (From the *Bot. Zeit.*, 1900, **58**.)

—— Über Pilze als Ammen und Ernährer höherer Pflanzen. (From the *Mitt. Nat. Vereines Steiermark*, 1907, **44**.)

—— Die Harze als pflanzliche Abfallstoffe. (From the *Mitt. Nat. Vereines Steiermark*, 1913, **50**.)

ROTH, GEORGE B. Some salient facts regarding the toxicity of arsphenamine and neo-arsphenamine. (From the *Arch. Derm. Syph.*, 1920, N.S. **2**.)

—— The effect of shaking alkalinized aqueous solutions of arsphenamine and aqueous solutions of neo-arsphenamine in the presence of air. (From the *Pub. Health Reports*, 1920.)

SCIENTIFIC AND INDUSTRIAL RESEARCH, Department of. *Fuel Research Board.* Technical Paper No. 1. The assay of coal for carbonisation purposes: a new laboratory method. By THOMAS GRAY and JAMES GRIEVE KING. London 1921. pp. ii + 13. ill.

SINNATT, FRANK STURDY, and HARRISON, W. The determination of the carbon dioxide in coal. (*Lancs. and Cheshire Coal Research Assoc.*, Bulletin No. 7.) 1920. pp. 15.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, held in the Lecture Hall of the Institution of Mechanical Engineers on Thursday, April 7th, 1921, at 8 p.m., Sir WILLIAM J. POPE, K.B.E., F.R.S., Vice-President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society, through death, of:

	Elected.	Died.
Alexander Wynter Blyth	June 3rd, 1875	March 30th, 1921
John Robert Cowburn	June 18th, 1908	Feb. 8th, 1919
Alfred Edward Hawkes	Dec. 2nd, 1880	1913
Herbert Yabsley Loram	Feb. 20th, 1873	March 23rd, 1921
Julius Ostersetzer	Dec. 1st, 1887	Nov. 27th, 1920
William Cobden Samuel	May 4th, 1882	Jan. 15th, 1920

Certificates were read for the first time in favour of:

William Bennison, 2, Shawfield Street, Chelsea, S.W. 3.
Arthur William Billett, 7, Sunnybank, Lyncombe Vale, Bath.
Robert Caden, 32, Whitburn Street, West Hartlepool.
Harry Clinton Davies, 83, Darlaston Road, Walsall.
Gladys Farnell, B.Sc., The Penn Club, 8, 9, 10, Tavistock Square, W.C. 1.
Alfred James Foord, 98, Fleet Road, Hampstead, N.W. 3.
Sudhindra Nath Ghose, B.Sc., 15, Provost Road, Hampstead, N.W. 3.
Herbert Gott, 14, Fell Croft, Dalton-in-Furness, Lancs.
William Green, South Parade, Northallerton.
Reginald Herman Roland Harry, Apartado 42, Bilbao, Spain.
Leonard George Hulls, c/o Messrs. Peek, Frean & Co., Ltd., Drummond Road, Bermondsey, S.E. 16.
James Sowden Jennings, 5, Portland Villas, Bath Street, Dewsbury.
William Whittle Kay, B.Sc., 133, Lee Lane, Horwich.
Charles Leaver, Hope House, Winkfield, Windsor.
Margaret Le Pla, B.Sc., 35, Villiers Road, Southall.

Frank Alfred William Livermore, B.Sc., 94, Bankes Road, Small Heath, Birmingham.
Qasim Ali Mansuri, M.Sc., 18, Hartington Grove, Cambridge.
Sydney William Royle Mottram, 178, Lloyd Street, Moss Side, Manchester.
Thomas Henry Poulson, Bull Hill, Stafford.
George Raymond Rumsey, B.Sc., High Street, Hornchurch, Romford.
Henry Edward Smith, Oakdene Villas, South Street, Cottingham, Yorks.
John Smith, B.Sc., A.I.C., 31, Dempster Street, Greenock.
Henry Austin Wilkinson, 41, Nun Mill Street, Scarcroft Road, York.
Willie Horner Wilkinson, Flush Lodge, Heckmondwike.
Christopher Percy Wilson, 8, Rivington Road, Pendleton, Manchester.
Stanley Wilson Worrell, 43, Winchelsea Road, Tottenham, N. 17.

A certificate has been authorised by the Council for presentation to ballot under Bye-law I (2) in favour of:

Guy Yandall Williams, M.A., M.S., Ph D., 468, Elm Avenue, Norman, Okla., U.S.A.

Dr. F. W. Aston then delivered his Lecture, entitled, "Mass Spectra and Atomic Weights." A vote of thanks to the Lecturer, proposed by Prof. H. E. Armstrong, F.R.S., seconded by Prof. J. F. Thorpe, F.R.S., was carried with acclamation, and acknowledged by Dr. Aston.

Ordinary Scientific Meeting, Thursday, April 21st, 1921, at 8 p.m., Sir James Walker, D.Sc., F.R.S., President, in the Chair.

It was announced that the Society had lost, through death, the following Fellows:

	Elected.	Died.
Bertram Blount..................	Mar. 6th, 1890.	April 9th.
Arthur Hartley	Mar. 16th, 1882.	April 13th.
Richard Henry Vernon	June 20th, 1918.	April 9th.

The President announced that the following Committees for 1921–1922 had been appointed by the Council:

Finance Committee.—Messrs. E. F. Armstrong, A. Chaston Chapman, C. A. Hill, G. T. Moody, and the Officers.

House Committee.—Messrs. J. L. Baker, Sir Herbert Jackson, Alexander Scott, Sir William A. Tilden, E. W. Voelcker, and the Officers.

Library Committee.—Messrs. O. L. Brady, Sir Thomas K. Rose, E. J. Russell, J. M. Thomson (*Chairman*), Sir William A. Tilden, C. K. Tinkler, the Editor, the Librarian and Officers, together with the following representatives of contributing Societies: Messrs. J. L. Baker, C. Dorée, J. C. Drummond, A. Harden, C. A. Keane, R. L. Mond, and G. Senter.

Publication Committee.—Messrs. A. J. Allmand, O. L. Brady, C. H. Desch, J. T. Hewitt, J. C. Irvine, C. A. Keane, T. M. Lowry, J. I. O. Masson, G. T. Morgan, T. S. Patterson, N. V. Sidgwick, J. F. Thorpe, and the Officers.

Research Fund Committee.—F. H. Carr, D. L. Chapman, Sir James J. Dobbie, G. G. Henderson, F. S. Kipping, R. H. Pickard, Sir William J. Pope, R. Robinson, Alexander Scott, S. Smiles, and the Officers.

James W. Cook, Cyril C. Wood, Thomas H. Hooper, and M. Carlton were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

George Bernard Brook, F.I.C., Edenmor, Kinlochleven, Argyll.
Alfred Herbert Dodd, B.A., A.I.C., Thornwick Cottage, Flamborough.
Cecil Sayers Harman, 139, Wakeham Road, Kensal Rise, N.W.10.
Louis Hunter, Plas Menai, Bangor.
Joseph Poulson, Bull Hill, Stafford.
Claude Moorhouse Stoney, 45, Trigon Road, Clapham Road, S.W.8.
George Frederick William Webb, 58, Arley Hill, Bristol.

A certificate has been authorised by the Council for presentation to ballot under Bye-law I (2) in favour of:

George Henry Philip Lichthardt, 2309, L Street, Sacramento, Cal., U.S.A.

The following papers were read:

"Organo-derivatives of bismuth. Part IV. The interaction of the halogen derivatives of tertiary aromatic bismuthines with organo-derivatives of magnesium and mercury." By F. Challenger and C. F. Allpress.

"A colloid theory of the corrosion and passivity of iron and of the oxidation of ferrous salts." By J. A. N. Friend.

"Researches on co-ordination and residual affinity. Part IV. The constitution of simple and complex cobaltic quinoneoxime lakes." By G. T. Morgan and J. D. Smith.

"Influence of position on the solubility of the substituted benzoic acids." By N. V. Sidgwick and E. K. Ewbank.

"Influence of position on the solubility and volatility of the mono- and di-nitrophenols." By N. V. Sidgwick and W. M. Aldous.

"The solubility and volatility of the chloro- and nitro-anilines and their acetyl derivatives." By N. V. Sidgwick and H. E. Rubie.

ORDINARY SCIENTIFIC MEETING.

The next Ordinary Scientific Meeting will be held on Thursday, May 5th, at 8 p.m., when a ballot for the election of Fellows will be held.

INFORMAL MEETING.

The next Informal Meeting of the Society will be held on Thursday, May 19th, after the conclusion of the formal business of the Ordinary Scientific Meeting, to be held at 8 p.m.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June next. Applications for Grants, to be made on forms which can be obtained from the Assistant Secretary, Chemical Society, Burlington House, W.1, must be received on or before Wednesday, June 1st, 1921.

All persons who received grants in June, 1920, or in June of any previous year, whose accounts have not been declared closed by the Council, are reminded that reports must be returned by Wednesday, June 1st, 1921.

ANNIVERSARY DINNER.

The Anniversary Dinner of the Society, to which the Past-Presidents who had attained their Jubilee as Fellows were invited as Guests of Honour, was held at the Hotel Cecil, Strand, W.C.2, on Thursday, March 17th, 1921, at 7.30 p.m. The following is a list of Fellows and their Guests who were present:

Adeney, W. E.
Allmand, A. J.
Ashton, Miss W.
Atack, F. W.
Bach, E.
Baker, H. B.
Baker, J. L.
Barber, C. O.
Barcroft, J.
Barr, G.
Berry, A. J.
Bledisloe, Lord.
Bolton, E. R.
Bolton, Mrs. E. R.
Borland, W. D.
Borland, Mrs. W. D.
Bragg, Sir W. H.
Brown, H.
Browning, K. C.
Browning, Mrs. K. C.
Brownlie, D.
Burgess, W. T.
Carlton, Miss M.
Carlton, T.

Carr, F. H.
Carr, Mrs. F. H.
Carr, S. E., *Assistant Secretary.*
Chambers, P. H.
Chapman, A. C., *President, Institute of Chemistry.*
Chatt, Miss E. M.
Clifford, F. W., *Librarian.*
Coates, J. E.
Cofman-Nicoresti, Miss B.
Cofman-Nicoresti, J.
Colgate, R. T.
Colman, H. G.
Coste, J. H.
Coste, Mrs. J. H.
Crossley, A. W., *Foreign Secretary.*
Daily Telegraph, Editor.
Dale, H. H.
Dewar, Sir J., *Past-President.*
Dewar, Lady.
Dixon, H. B., *Past-President.*
Dobbie, Sir J. J., *President.*
Dobbie, Lady.
Donnan, F. G., *Vice-President.*
Drummond, J. C.
Dudley, H. W.
Dyer, B.
Egerton, A. C. G.
Elam, Miss C. F.
Ellingham, H. J. T.
Evans, C. L.
Evans, E. V.
Fargher, R. G.
Fargher, Mrs. R. G.
Farmer, J. B.
Feasey, G. T.
Field, H. E., *President, Institute of*

Forster, M. O., *Treasurer.*
Fox, J. J.
Fraser, J. R.
Frink, R. L.
Gardiner, J. H.
Gardner, J. A.
Gibson, C. S.
Gilbard, J. F. H.
Gillick, E.
Golding, J.
Goodson, J. A.
Goodson, Mrs. J. A.
Gray, W. H.
Greenaway, A. J., *Editor.*
Gregory, Sir R.
Griffiths, Miss M. E.
Hamer, Miss F. M.
Hamer, W. H.
Hamer, Mrs. W. H.
Harden, A.
Harvey, Miss I. K.
Haworth, W. N.
Haywood, E. H., *Prime Warden, The Dyers' Company.*
Heath, Sir F., *Secretary, Department of Scientific and Industrial Research.*
Heath, J. W.
Henry, T. A.
Hewitt, J. T.
Heycock, C. T.
Hill, C. A.
Hinchley, J. W.
Hinks, E.
Hooper, E. G.
Hooper, G. G.
Hope, E.
Horton, E.
Howard, H. L.
Hutchinson, A.
Ingold, C. K.
Jenkins, L. C. W.
Johnson, Miss M.
Johnson, Miss R.
Jowett, H. A. D.
Jowett, Mrs. H. A. D.
Keane, C. A.
Kenner, J.
Kenyon, Sir F. G., *President, British Academy.*
Kenyon, J.
Keogh, Sir A., *Rector, Imperial College of Science and Technology.*
King, G.
King, H.
Kipping, F. S.
Lacell, H. G.
Leighton, E. W.
Le Pla, Miss M., *Indexer*
Le Sueur, H. R., *Secretary.*
Levinstein, H.
Levy, N. L.
Lewis, S. J.
Lewkowitsch, Mrs. J.
Lindemann, F. A.
Lovatt, H. W.
Lowry, T. M.
McCombie, H.

McDougall, Miss.
McGowan, G.
Maclean, Mrs. I. S.
Maclean, H.
Macnab, W.
Marlow, G. S. W.
Marlow, Mrs. G. S. W.
Mattingley, N. B.
Mattingley, Mrs. N.
Mernagh, L. R.
Micklethwait, Miss F. M. G.
Mills, W. H.
Mond, Sir A., *First Commissioner of Works.*
Mond, R. L.
Monier-Williams, G. W.
Monier-Williams, Mrs. G. W.
Moreland, H.
Morison, C. G. T.
Morning Post, Editor.
Morris, H. J.
Morton, C.
Moss, E. W.
Moureu, C., *Vice-Président, La Société Chimique de France.*
Paget, H.
Perkin, W. H., *Past-President.*
Perman, E. P.
Petavel, Sir J., *Director, National Physical Laboratory.*
Philip, J. C., *Secretary.*
Philip, Mrs. J. C.
Pickard, R. H.
Pickard, Mrs. R. H.
Pilley, J. J.
Pizey, J. H.
Porritt, B. D.
Prain, Sir D., *Treasurer, The Royal Society.*
Pratt, J. D.
Press Association, Editor.
Price, T. S.
Pyman, F. L.
Pyman, Mrs. F.
Raworth, J. E.
Reichel, Sir H., *Principal, University College of N. Wales.*
Reilly, J.
Renouf, Miss N.
Robertson, Sir R.
Robertson, Lady.
Robinson, R.
Rodd, E. H.
Rogerson, H.
Rogerson, W. A.
Rushworth, D.
Russell, A. S.
Sandover, J. A.
Saraiya, R. G.
Sargant, Mr. Justice.
Scott, A., *Past-President.*
Scott, Mrs. A.
Seaton, C. T. J.
Senter, G.
Shaw, Mrs. M.
Sherrington, C. S., *President, The Royal Society.*
Sidgwick, N. V.
Simmons, W. H.
Sinkinson, E.
Smith, C., *Assistant Editor.*
Smithells, A.
Spencer, J. F.
Spielmann, M. H.
Spielmann, P. E.
Stubbs, G.
Tallantyre, S. B.
Taylor, Miss C. M.
Thomas, E. R.
Thomas, Miss M. B.
Thomas, N. G.
Thorne, L. T.
Thorpe, J. F.
Thorpe, Mrs. J. F.
Threlfall, Sir R.
Tidd, M. W.
Tilden, Sir W. A., *Past-President.*
Times, Editor.
Tinkler, C. K.
Tinkler, Mrs. C. K.
Tripp, E. H.
Tucker, T.
Upton, Miss.
Voelcker, E. W.
Voelcker, Mrs. E. W.
Voelcker, J. A.
Waller, A. D.
Wells, S. R., *Vice-Chancellor, University of London.*
Whiteley, Miss M. A.
Widdicombe, J. H.
Widdows, Miss S. T.
Williams, Miss M.
Woolcock, W. J. U.
Wynne, W. P., *Vice-President.*
Youll, J. W. R.

The following Toasts were proposed :—

By THE PRESIDENT :—

1. "His Most Gracious Majesty the King." 2. "Their Majesties the Queen and Queen Alexandra, His Royal Highness the Prince of Wales, and other Members of the Royal Family."

By THE RIGHT HONOURABLE SIR ALFRED MOND, BART., P.C., M.P., First Commissioner of His Majesty's Office of Works :—

3. "The Chemical Society, coupled with the name of The President."

By PROFESSOR HAROLD B. DIXON, C.B.E., M.A., F.R.S., Past-President of the Chemical Society :—

4. "The Past-Presidents, coupled with the names of Sir James Dewar, M.A., LL.D., F.R.S., President, 1897–1899; Sir Edward Thorpe, C.B., D.Sc., F.R.S., President, 1899–1901; Sir William A. Tilden, D.Sc., LL.D., F.R.S., President, 1903–1905.

By PROFESSOR FREDERICK G. DONNAN, C.B.E., M.A., F.R.S., Vice-President of the Chemical Society :—

5. "The Guests, coupled with the names of Monsieur le Professeur Charles Moureu, Vice-Président de la Société Chimique de France; The Honourable Mr. Justice Sargant; Professor C. S. Sherrington, M.A., D.Sc., F.R.S., President of the Royal Society."

The Loyal Toasts having been honoured, Sir ALFRED MOND, Bart., M.P., in proposing "The Chemical Society," said :—

I feel it is a very great honour and distinction that I have been asked to-night to propose the health of the Chemical Society, the origin of which now dates back a great many years—to 1841. The Society has such a distinguished record, both of Presidents, members, and work, that it is indeed not easy to find fresh words to say about it. It is an old, revered, and blameless institution. It proceeds on well-established and successful lines. One distinguished man succeeds another in the Chair. I have not observed, in reading its history, that it is apt to burst out into new or international lines of work or research, or that its membership or finances are subject to violent fluctuations. It is a Society the first President of which was so distinguished a man as Thomas Graham, and which included in the past men of the type of Hofmann. As long ago as 1861 it stood as the symbol of the great chain of chemists who have distinguished this country. I have mentioned Hofmann's name, and it is interesting to realise that that great chemist, who did so much later on to further that dye industry of which we hear so much now, and which was so entirely forgotten for two generations in this country, was President of this Society from 1861 to 1863.

It is fashionable now for politicians, statesmen, and the Press to talk about the dye industry. We always discover the novelties of

science about fifty years after scientific men have finished with them. What makes one somewhat apprehensive is that the same spirit which drove Hofmann from England and which helped to drive the dye industry to Germany has not yet died out. I speak with a little feeling, and I will tell you why.

A short time ago it was my misfortune, as part of my duty, to introduce some estimates in the House of Commons, and the subject which caused, I think, most discussion, and brought most criticism on my devoted head, was the fact that we were spending a few hundred pounds for a test laboratory. "As though anybody now requires research," they said; "as though in these days of financial stringency and squandermania it was necessary to provide buildings in which research could be carried on!" "Who wanted research into the behaviour of concrete or the effect of moisture on building materials?" I was told, "Why not send for a practical builder, who will put you up a house and will not require research?" I did my best, as I was in duty bound, having been trained in science and having profited by research in many ways, to defend, I hope successfully, the importance of research, the necessity of research, and the economy of research in these days. One would hope that people would have learned by this time what science meant to this country, to this Empire, and to the world.

During the war, we all know that when the greatest difficulties occurred and people who had never thought about chemistry at all were stuck, it was to the chemist and the engineer they had to turn to solve their problems, to provide them with armaments, and to win the war. I sincerely trusted that with that lesson still ringing in their ears it would be recognised, even by the uninitiated, that science and research were not the fads of the few or the follies of the aged, but were vital necessities to the existence of the nation, and never more so than at a time of financial emergency.

If you compare the conditions of the world to-day with the conditions of the world after the great Napoleonic wars, you will find that after the great Napoleonic wars the world was in a state of exhaustion more profound than it is to-day. The position in this country at that time as regards taxation and the poverty of the people was terrible, and I do not believe that any real recovery of a rapid character was possible or that there could have been any cure for generations had it not been for the development of the steam engine and of industry. It was science which came to the rescue of humanity and replaced the capital which was destroyed during that war by methods of better production. We are to-day in exactly the same position. The key to the recovery of Europe lies, not in financial jugglery in extracting

money which does not exist from people who have not got it; it does not even lie in reducing the wages of workmen; it lies in some great improvement in our methods of production, some great discovery as fundamental and far-reaching as that of the steam engine in its epoch, to enable us to recruit that capital which has been destroyed in the last five years. If this is true, and I believe it is fundamental, it surely follows that, far from the curtailment of research, this is the very time when sheer necessity and self-defence for the continuation of civilisation demand that we should strive for more research and for more expenditure on research. When we are all comfortable and there is nothing very much happening, we can linger longer over making progress, but now progress has to be swift, rapid, and keen.

One thing which struck me during the war was the German attitude towards this subject. Through the courtesy of a friend, I was able to see the agenda of a meeting which the German Steel and Iron Institution held during the war. They were laying out a long programme of research work on blast furnaces, pig iron, and coke, and a whole series of carefully conceived experiments was conducted in the middle of the war. I felt that this rigorous belief, in times of great distress, in the necessity for scientific progress was a greater menace to our country than all the Hindenburgs, Ludendorffs, and Tirpitzes Germany could produce. I am, therefore, glad, of the opportunity, to-night, to propose the health of your Society, which represents so nobly the chemists of this country.

I have left in the dim past, I am afraid, the chemical knowledge, small as it was and hard as you tried to teach me, which I once possessed. It never got very far, but I did imbibe the knowledge of the value of scientific work and training which never leaves one and keeps one always in sympathy with the many important and interesting developments which take place. Chemistry to-day has become very complicated and very different from what it was in my young days. I believe everything I learned has now been proved to be wrong. It is somewhat discouraging to go on for that reason. Many new branches have developed, some of which will prove of enormous importance in the solution of so many of our problems, while others which have sprung up have been transferred from the laboratory to the factory. I think if one fact emerges from the last twenty or twenty-five years of chemical work, it is that there is no experiment which has been made in the laboratory of which you could say positively that it might not prove of the greatest value to industry. Things which look remote, therefore, often become the links of immediate progress. There are some people who have the idea that you can order research as you order a

suit of clothes, and that if you only establish a laboratory and hire people for research you can by that method obtain world-stirring results. Real research, like the arts, is born in one, and the important thing is to give the worker the opportunity, free from care, to do what he thinks right, not what someone else wants him to do, for that is how the great discoveries of the world have been made. A great man of science is like a great poet, or a great prophet; his mind acts partly unconsciously, and it peers into the distance. Suddenly, illuminating ideas flash across the darkness of his mind, but what they mean or may lead to neither he nor anyone else can tell. These illuminations across the vast track of undiscovered territory still lying before us are the real beacon lights by which we shall reach in time that fuller knowledge of the world towards which the human race has striven ever since men became conscious and self-conscious human beings. To that, everyone who has the privilege of being allowed to dwell in the temple of science will agree.

I am very pleased that I am asked to associate with this toast the name of your President, Sir James Dobbie. Sir James Dobbie is the worthy successor of a long line of distinguished predecessors. He has behind him a great record of service to the Government, to the country, and to science. He has done great work during the war in helping the country, work which I am sure all those here recognise and all those who know appreciate to its fullest extent. I give you the toast of "The Chemical Society," coupled with the name of Sir James Dobbie.

Sir James J. Dobbie, in response, said:—

My first duty is to thank Sir Alfred Mond on behalf of the Society for the very generous terms in which he has proposed this toast and for his eloquent advocacy of the purposes for which this Society exists.

It has been the practice of my predecessors on these occasions to give some account of the chief incidents in the progress of the Society during their term of office, but the last two years have been so crowded with incident that, having regard to the programme before us, I must limit myself to one or two points of special interest.

The Society has now been in existence for eighty years, and the Charter under which we are incorporated dates back to the twelfth year of Queen Victoria's reign. For some time past some of our Fellows have felt that the rights and privileges we enjoyed under such a Charter are not, perhaps, those best suited to present-day requirements. We were, for example, under our original Charter, limited as to the size of our Council. We were limited also as to

the methods by which we could take votes and obtain an expression of the opinion of our Fellows. It was thought desirable, therefore, that we should apply for a supplemental Charter to remedy these and other matters in need of reform, and this we have now succeeded in obtaining. The general effect of the changes which we have, in consequence, been enabled to effect is to afford to Fellows ampler opportunities than formerly for taking a direct part in the business affairs of the Society.

Another alteration which was highly desirable has also been provided for in our supplemental Charter. We have ladies with us to-night for the first time. We have in the past welcomed ladies to our meetings and given them such privileges as it was competent for us to give under our Charter and Bye-laws, but it was felt by many that the time had come to admit them to the full rights and privileges of Fellowship. I have had a long acquaintance with ladies—I mean as chemists—I knew them in my younger days as students, and I knew them later as assistants, and I found them excellent both as students and assistants. They have also shown by their contributions to our Transactions that they are competent to advance the interests of science by research. They possess, therefore, all the qualifications which we desiderate in our Fellows, and when the proposal to alter our Charter so as to admit them to the status of Fellows was put forward by the Council, it was adopted by the Society as a whole and duly incorporated in the supplemental Charter. I count it one of the chief distinctions of my term of office that it was my privilege to admit the first ladies to the Fellowship of the Society.

Like other kindred societies, we have recently passed through a period of some financial difficulty. The cost of our establishment has necessarily increased and the cost of the publications has also greatly increased owing to the rise in the price of paper and in the wages of the printers. After exercising every possible economy it was found that only a very little of the gap between the two sides of the balance sheet could be made good in this way, and we were faced with the alternative of either increasing our subscription or limiting our activities. The latter course was extremely distasteful to all of us. We recognised that there never was a time when the Society could render more valuable service than at the present, when the interests of the country so imperatively demand that more attention shall be directed than ever before to scientific education and research. We were therefore most unwilling to adopt any limitation, although the difficulties attending the alternative course were great. A large number of our Fellows are young men to whom an increase in the subscription was by no means a

matter of indifference. We had to consider their interests, and we had to consider what the effect of raising the subscription might be on our numbers. We decided to take the risk, and at the end of 1920, although the resignations were somewhat more numerous than usual, they were more than compensated for by the new entries. Our numbers in 1914 were 3,205, in 1919 they were 3,569, and in 1920, 3,721—a gain of 152 in the year. The method of making our accounts balance which we adopted was therefore entirely justified. I think that the increase in our numbers shows that throughout the profession the benefits of belonging to this Society are very generally felt and appreciated.

But I would not have you think that we measure our usefulness by counting heads. We have a better method than that of estimating the progress of the Society and the good it is doing in the cause of science, by the papers which are printed in our Transactions. These are all subjected to a close scrutiny before they are admitted to the Transactions, and I do not think any paper is ever printed which does not contain some fact which is new to science. It was one of the calamities of the war that the progress of science was in many of its branches almost entirely suspended, but it is gratifying to find that the recovery has begun. In 1914 we published 272 papers, in 1918 the number had fallen to 89, the lowest record in recent years, but last year it had risen again to 182. That shows that the Universities and Technical Colleges are getting to work again, and that research is once more being actively prosecuted. Before long, I have no doubt we shall be back, and more than back. to the figures of 1914.

The success of the Society brings with it its own embarrassments. We occupy rooms in Burlington House, and I hope that the First Commissioner of Works will not think I am about to say anything ungracious with regard to the hospitality which his Department affords us; but the fact is that that hospitality is now wholly insufficient for our purposes. Our rooms, which were barely sufficient when I first became a Fellow of the Society, I am afraid to think how many years ago, are now wholly insufficient for the purposes of our ordinary meetings. They are overcrowded and inconvenient on these occasions, and when we have special lectures we are obliged to seek accommodation elsewhere. Moreover, we have no space at Burlington House for much needed developments of our library. I am not going to embarrass Sir Alfred Mond by suggesting that he should find us additional accommodation at Burlington House, for we recognise that that is impossible. We have another plan altogether. We have recently federated the Chemical Society with the Society of Chemical Industry and

other societies concerned with chemistry, and we now wish to give this Federation an outward and visible symbol. I do not need to enlarge on the benefits which a common meeting-place for the members of all the societies interested in chemistry would confer on the profession, or on the advantage of having at our disposal premises large enough to allow of the development of the excellent library we already possess into a truly national library of chemistry. This project appealed strongly to Lord Moulton, whose death we are all deploring at the present time. It engaged his sympathy and had his active support, and I have no doubt that if he had lived it would have been realised with his aid. We recognise, of course, that the present is not a favourable time for prosecuting such a scheme. You may ask, then, why I mention it. I answer, we must keep our aspirations and ideals alive in these days. Besides, there are still, I believe, a few millionaires left amongst us, and it may be when this want, which is a truly national want, becomes known, that some one of them may be inspired with the wish to do a great service to his country and to the profession which did so much for the country in its recent time of trial, by providing us with a worthy habitation.

I ought to have said earlier how much we are indebted to the energy and tact of our senior Secretary, Professor Philip, and to his wide knowledge of the *personnel* of the Society, in connection with the changes which have recently been effected in the constitution of the Society.

Before I sit down I should like on behalf of the Society to thank Professor Moureu, who has come specially to London to bring us a message of goodwill from our sister society in Paris. You will have an opportunity of hearing him later in the evening, but I wish to thank him now on behalf of the Society for his presence here to-night. I have been asked by Sir Edward Thorpe, Prof. A. Crum Brown, and my successor in office, Sir James Walker, to express their great regret that they are unable to be here to-night.

Professor HAROLD B. DIXON, C.B.E., F.R.S., in proposing the Toast of "The Past-Presidents," said :—

When the history of the Chemical Society comes to be written the chronicler will surely note that the toast of the Jubilee Past-Presidents which has been proposed twice before in our annals—first in 1898 by our senior Guest this evening, Sir James Dewar, when President, and again twelve years later by a more humble successor—was given on both occasions at a time and date that will be ever memorable—the eleventh day of the eleventh month and almost at the eleventh hour. From such a happy augury, which

links our great departed with the close of the Chemists' War, may we not hope to set up another date with auspices no less propitious—linking the names of our living Past-Presidents with an era when Chemistry returned to her own pure ideals—the search for truth and the advance of humanity?

I was given three names to couple with this toast, those of Sir James Dewar, Sir Edward Thorpe, and Sir William Tilden—all of whom I would claim as my friends, all of whom I look up to as my chemical masters. You know the difficulty of being personal and yet impartial which is inherent in my task—so I am going to take refuge behind the sentiment quaintly expressed by that provincial mayor who, in laying down his office said: "Gentlemen, I have conscientiously trodden the narrow path that leads between right and wrong, never swerving on the one hand to partiality nor on the other to impartiality!"

Sir James Dewar.
President 1897—9.

This toast is coupled first with the name of Sir James Dewar, of whose discovery Lyon Playfair used to boast when he claimed to have brought to light those two very "active radicals" Frankland and Dewar. Seduced for a space by the attractions of Kekulé at Ghent, Dewar wandered down the primrose path of organic chemistry plucking scented garlands from picoline and quinoline by the way—but stopped and retraced his steps before the steep and slippery descent to Avernus forbade return. Why, then, we wonder, should he alone among chemists have been deified in his lifetime, and enthroned as a modern Pluto in charge of the infernal regions? But the legend remains—they repeat it with only slight variations throughout the English-speaking world—that the newcomer on reaching the portals of Hades is astonished to find a pleasant sub-tropical climate—with a choice of well-cooled drinks in silvered vacuum flasks—and is told that this is the new *régime* since Sir James was elected Boss by his fellow chemists and installed his liquid-air plant. The story may be an anticipatory compliment, for we can appreciate that there is no region, on earth or beneath it, that the Scot will not dare to penetrate in a good cause when we remember the declaration of a dour Elder of the Kirk at a recent by-election to Parliament: "Kirkcaldy means to have a real religious man for its member, aye, if we have to go to Hell to fetch him!" But Sir James has no intention of anticipating any such crown to his career. Still hale and in mental vigour, he can celebrate his eightieth birthday, on which we all congratulate him; and still

more can we congratulate him on the golden wedding with the gracious lady who is by his side to-night, as she has been through all these strenuous years of effort and achievement—and what years they were!

From the hydrogenium of 1869 to the liquid hydrogen of 1898 was a long long way, but Dewar trod it with unfailing skill and perseverance. If he has not yet reached the absolute zero, he has himself hewn the only way by which the Nadir of Temperature can be reached, and he has approached it near enough to point out the chief landmarks of that region where chemical action ceases and electrical resistance disappears. It is a record of achievement on which the successor of Davy and Faraday may rest well-satisfied that he shares their fame.

Sir Edward Thorpe.
President 1899—1901.

Sir Edward Thorpe we all expected to see and hear to-night; we all regret the malady which keeps him away and wish him a complete and speedy recovery.

Manchester and Owens College look on Thorpe as one of the truest and doughtiest of their sons. The student, the assistant, and the ally of Roscoe, did he not seem designed by birth and training, by achievement and loyalty—and almost by right of primogeniture—to succeed to the Master's Chair? I suppose Thorpe, and others like him, had to go elsewhere—or how, otherwise, could the rest of England be persuaded to think to-morrow what Manchester is thinking to-day?

From the early days of the Owens College Union, the Debating Society, and the Boat Club, we find Thorpe taking a guiding part as secretary, as organiser, and as cox. of the laboratory "Four." After being swamped in the inky Irwell, it must have been child's play to him to be wrecked on his first eclipse expedition. For Thorpe embodies the virtue of the old Roman "rebus angustis animosus" (full of beans in a tight place), and these early aquatic experiences have only drawn him more strongly to the sea. If and when he ever slacks off from chemistry it is to become chemist and sailor too.

To his great gifts as an experimenter and to a power of work that has accomplished so much enduring output, has been added a critical judgment which, coupled with his literary precision and charm, has made his historical writings as satisfying in argument as they are pungent and delightful in flavour.

Nothing has been foreign to Thorpe's genius for investigation—

from the light of a cloudless sky to the coal dust that would wreck a mine. We may say of him, not only has he adorned what he has touched, but wherever he has hit he has struck fire.

Sir William Tilden.
President 1903—5.

I have heard it stated, and looking at his career I can well believe it, that Sir William Tilden is a lineal descendant of that distinguished alchemist of the sixteenth century Johan Thölden, who not only was *the* authority on salts and their reactions, but the real author of the work commonly attributed to Basil Valentine, the famous Triumphal Car of Antimony. No wonder then that Aqua Regia, the most powerful weapon in the armoury of the alchemist, exerted its magic on the young mind of our Past-President and led to experiments which first explained the nature of its action through the formation of nitrosyl chloride. With the new weapon in his hand, Tilden attacked the constitution of the terpenes, and by the formation of the nitrosochlorides greatly facilitated their study.

In the region of physical chemistry, Tilden has also done classical work. The Law of Dulong and Petit that "the atoms of all elements have exactly the same capacity for heat" was one of the "Tria Prima" of the nineteenth century chemists in fixing formulæ and atomic weights—especially after Weber had shown that the specific heats of carbon, boron, and silicon apparently ceased at high temperature to be exceptions to the rule. But Tilden's work on carbon, aluminium, nickel, and other metals proved that all specific heats rise with the temperature, and we are driven to the conclusion that if there is equality it is to be found at the other end of the scale, where the atomic heats shrink to the vanishing point.

Tilden's work on the specific heats of the metallic oxides led him to probe the structure of the molecules in crystals where he saw "The atoms tactically arranged in the closest order"—saw with his mind's eye the ordered ranks and files now revealed by *X*-ray analysis.

In 1878 Tilden began the famous work on isoprene, by which he showed how the terpenes were built up by the polymerisation of isoprene, and how turpentine, on the other hand, could be depolymerised into isoprene. Then came the crown of his synthetic work, and if his great ancestor drove a triumphal car through the medical prejudices of his time, surely we may greet in the modern Tilden the *Deus ex machina* who solved the scientific riddle of rubber and proved the possibility of its artificial manufacture.

Sir James Dewar replied :—

I wish to express the very high appreciation which I feel of the way in which the Society has honoured me to-night. It is now some twenty-three years since I had the honour to preside—as our President has done to-night—at a dinner of this character. I know well the anxiety and worry such a gathering involves and the amount of labour in the background which it entails. It is worth doing, however, for the pleasure that it gives to the younger members, and that is a matter of importance. That veterans should be rewarded by such an acknowledgment appeals to most people and to me particularly because I have always loved youth. I think age without coming into contact with youth in some way or other is a perfect horror.

To meet the younger generation of chemists is something to appreciate. One must never forget what the poet said :—

> "Let me not live
> After my flame lacks oil, to be the snuff
> Of younger spirits, whose apprehensive senses
> All but new things disdain."

It is of vital importance that the younger generation should respect the veterans and the past history of their science. It is a sad neglect that is prevalent in the younger school to appreciate nothing but what is novel and in the vanguard of progress.

The encomium which has been passed on my work by Professor Harold Dixon, of course, is much exaggerated. I have stood the infernal regions, as he has described them, fairly well. I have had many troubles and many accidents. Connected in early days with explosives, later with high temperatures, and finally with low temperature work, I have run the gamut as a pioneer in many fields of scientific inquiry.

The only other occasion in my life when I was in the position I am in to-night was forty-six years ago, when my Edinburgh colleagues gave me a dinner, when I was to waft, as is usual with Scotsmen, southwards. One incident of the dinner stands out in my memory. The usual Grace before dinner was given by a Doctor of Divinity, and after dinner, the chairman, who was a Past-President of this Society, made a call again upon the reverend doctor for Grace after meat. The doctor replied, "No, we have had enough of this to-night." A professor of medicine sitting beside him said, "Well, doctor, you might give us a Biblical quotation instead." "Very well," replied the doctor, "I will do that. 'Sun and the moon endure.'" I have endured a long time, and, as Professor Dixon has revealed, this is a special year

for me and for my wife, who has been the helpmate and stimulus of my life. I hope we may live till the autumn when our Golden Wedding occurs.

I may add to Professor Harold Dixon's speech one or two characteristic points in my career. It was my fortune in boyhood to benefit by misfortune. My success in life I regard as a product of disease. In Scotland in my early days there was a common disease amongst the young known as "growing pains." It was really rheumatic fever. There was no remedy known in those days and you had to get through the fever by a prolonged convalescence. The time of recovery in my case was spread over some two years, for the disease passed through every organ. During that time I had an opportunity of learning how to use my hands. The fascination which possessed me, which I think is an illustration of the good that can come out of evil, was to make fiddles. Scotland was a great country for fiddlers in those days. I learned to make violins, but discovered that they were not at all equal to the model Stradivarius I had copied, and yet they were the result of much labour. I even learned to play the violin fairly well, but discovered I was not going to be a Paganini, and thus I began life with a double defeat.

I then went to college in Edinburgh, and found that the use I had learned to make of my hands was of material importance in the making of experiments as compared with other students. The artistic use of my hands remains with me still, and I attribute my experimental aptitude entirely to my violin training. Do not neglect this kind of art in the young, for it does not in the least retard their scientific progress. It is a most important thing to initiate the correlation between brain and muscle at an early period.

My training fell into the hands of Playfair, Forbes, and that wonderful Edinburgh school, Goodsir, Christison, Syme, Simpson (of chloroform fame), and Bennett. They were men of genius and there was also a large literary set, so I got the benefit of the artistic on the one side and the scientific on the other. Playfair was an extraordinary man and had the most cultivated, refined, and diplomatic manner of any member of the professoriate. Gentleman Usher to the Prince Consort, trained under Graham and Liebig, a friend of Dalton's, and a colleague in scientific work with Joule, he had thus been brought into intimate contact with great personalities. When I mention the names of some of his assistants you will realise what a remarkable set they were. Before my time, there was Greville Williams, a man of great distinction and a pioneer in the synthetic dye industry; Guthrie, whose cryohydrates

and other work constituted landmarks of progress; Wanklin, and Dittmar. I am the last link as assistant between one of the original Founders and the Society as it exists to-day. Playfair died before the first banquet, at which he was to have been included amongst those you desired to honour.

Referring to my connexion with Kekulé and to the early power of attempting investigation in both organic and physical chemistry, I wish to explain how that arose. Scotland has always been very intimately connected with France, and with French studies and French opinion. James Forbes was still alive, with Balfour Stewart as his assistant, and French scientific work was brought before the students. My first love was undoubtedly the work of St. Claire Deville and his school. I lectured twice to the Chemical Society on "Dissociation" in the early days of 1870. That was one of the greatest strides in the development of chemical science. At the same time, I was much interested in Kekulé's ideas of organic structure, and, to illustrate it, I made a model which could easily be explained to students. Playfair thought well of it and sent it to Kekulé, who was pleased with it. He projected making a solid model, and it was arranged that I should go to Ghent and work in the laboratory during a summer session. I met there, as an assistant to Kekulé, the great Körner, a man of extraordinary aptitudes. It is strange to relate that Kekulé did not preach or advance Körner's view of the "Position Theory." Körner's papers were communicated to the Belgian Academy by Stas, and it is one of those remarkable cases that sometimes occur that a great chemist should not have properly appreciated a new advance in chemical theory.

In Ghent. the pyridine series oxidation experiments were continued. For a time, I oscillated between the French school of Deville and the organic school of Kekulé, finding later on that the physical side was the one to which I was best adapted.

One thing that must not be forgetten is that I have been very fortunate in the colleagues with whom I have worked. First, with MacKendrick, on the physiological action of light on the retina; and also on the action of quinoline bases on the organism. Then on high vacua with Tait; and later, for many years on spectroscopic problems with Liveing.

I have had the great honour of collaborating both with Moissan and the Curies. I have indeed had an exceedingly able set of colleagues helping to carry on research in various fields, and I must not omit Professor Fleming's co-operation in the study of electric and magnetic action at low temperatures.

I am not so great a chemist as has been represented by the

proposer of this toast; although I have done my share of work, do not overload me with honour.

> "Be those men praised of us,
> Who have loved, and wrought, and sorrowed, and not sinned,
> For fear, or fame, or gold,
> Nor waxed with winter cold,
> Nor changed with changes of the worldly wind."

If the new Fellows of the Chemical Society I have been privileged to see arise think I have the shadow of a claim to be included in the poet's definition, then I wish no further reward for merit. Thanking you all again, I may say "Farewell."

Sir William Tilden responded:—

Perhaps I may be permitted to remind you that on two previous occasions you have honoured your Past-Presidents who had the necessary age qualification by entertaining them in the same way that you are entertaining us to-night. I was present on both occasions. I remember them still, and if I simply read over to you the names of those who were honoured on those two occasions I think many memories will occur to most of you. In 1898 there were Gilbert, Frankland, Odling, Abel, Williamson, and Gladstone, and in 1910 there were Odling—Roscoe was prevented by illness—Crookes, Müller, and Harcourt. So recently as the early part of January I called on the then senior Fellow of the Society, Professor Odling, and so bright did I find him and so strong was his voice that I thought it probable that although he might not be present on an occasion like this he would survive to this day and thus have been for a third time the recipient of the compliment which it was desired by the Society to pay to their Past-President. I hope you will readily believe that although I was present on the two previous occasions of this kind it did not then occur to me that I should, however unworthy, find myself qualified by age to occupy a position such as you have accorded to me to-night. I find it difficult to express to Professor Dixon and to you in suitable terms my thanks for the honour you have conferred upon me.

My feelings I may perhaps illustrate by a very short anecdote. A few years ago, while I was still professor at South Kensington, I invited all my students, 120 of them, to tea one afternoon. The next day, after it was all over, I asked the secretary of the Students' Club whether he thought it had gone off pretty well. After a short hesitation, he replied, "I have heard no complaints." I think a man who reaches the end of his career and has heard no complaints is one who ought to be happy. I have heard no complaints, and I have escaped the whipping which Hamlet says every man deserves. With a thankful heart I realise that I am in the enjoy-

ment of all those things which Shakespeare says should accompany old age, "Honour, love, obedience, troops of friends." When I come to the Chemical Society I know I shall meet troops of friends. You will, I hope, readily understand my feelings on an occasion like this. Of course, I can talk for a long time about things of the past, and as you know, there is rather a tendency on the part of old gentlemen when they get on their feet with licence to speak to be a little tedious in their remarks. All I can say is that I have no words adequate to express my feelings, but I thank you most deeply and most cordially. That is enough about myself.

Perhaps you will excuse me if I look back into my recollections of the past in connexion with the Society. After comparing notes with Sir James Dewar, I believe I am about one month older than any other person in this room; but although my recollections extend a long way I do not go back to the foundation of the Society. Once I had the great honour of an interview with the first President, Professor Graham, and his talk with me was very flattering to a mere boy as I was then. I went to ask him to allow his wonderful experiment of pumping air through a sheet of india-rubber whereby oxygen could be extracted from it to be shown on a certain occasion. Next, perhaps, I may recall an event which has considerable interest, I think, in the history of the Society, a lecture that was given to the Society about 1864 by Professor Berthelot, who came to speak on chemical synthesis. You all know what Berthelot did, but I must spare your time and not enter into that. The next great event I remember was the magnificent first Faraday lecture, given by Dumas. There are many other occasions that I could recall. I remember the lecture given by one of our Past-Presidents, Dr. Williamson, on the Atomic Theory. At that time many people talked about the Atomic Theory as if it was a perhaps useful kind of hypothesis, but not to be treated seriously as representing anything within the range of physical science. I believe Odling himself was one of those who at that time did not (or if he did, only in a hesitating way) accept the atomic doctrine as taught by John Dalton.

If I were to extend my recollections, I should be telling you the whole history of the Society. I refrain from doing that, but should like to remind you, especially on this occasion when we welcome for the first time lady fellows of the Society to a meeting of the fellows, that the Society has not only a past, but, we may be perfectly certain, a great future before it. Times have changed very much. It is sufficient to remind you of the great change when I say that when I began to learn chemistry—and the first experiment I ever made was in 1857—it was under the Berzelian system of

atomic weights with the binary system of notation. I passed through a period which was perhaps more difficult than can be conceived by present-day students, the period which followed Cannizzaro's great discourse which he embodied in the Faraday Lecture some years later. As a consequence of this, when I attended Hofmann's lectures the atomic weights of carbon, oxygen, and sulphur were first changed and then those of certain metals. We also changed from the binary system to the unitary system of notation. Compared with the confusion we were thrown into at that time the present system of teaching the ionic doctrine to young students is quite a simple matter. I would like to say with regard to the future of the Society, and the research upon which it necessarily lives, that although we have changed experimental methods and theoretical views it is necessary for the existence of the Society and for the progress of science that the same spirit should prevail as in the times long past of which I have been speaking.

Let me conclude by saying once more I thank you most cordially, for I regard this as the great event of my life.

The toast of the "Guests" was then proposed by Professor F. G. DONNAN, to which M. le Professeur CHARLES MOUREU, Vice-Président de la Société Chimique de France, The Honourable Mr. JUSTICE SARGANT, and Professor C. S. SHERRINGTON, President of the Royal Society, responded

ADDITIONS TO THE LIBRARY.

I. *Donations.*

BRITISH ECONOMIC MISSION TO SERBIA. The geology and mineral resources of the Serb-Croat-Slovene state: being the report of the geologist. By D. A. WRAY. London 1921. pp. 108. ill. (*Reference.*) From the Department of Overseas Trade.

FUHRMANN, FRANZ. Vorlesungen über Bakterienenzyme. Jena 1907. pp. viii + 137. ill. (*Recd.* 30/3/21.) From the Author.

HALE, ARTHUR JAMES. Modern chemistry, pure and applied: a treatise dealing with all branches of chemistry: mineral, metallurgical, organic, pharmaceutical, and industrial. Vol. I. London [1921]. pp. xii + 272. ill. 16*s*. net. (*Recd.* 7/4/21.)
From the Publishers: Messrs. Virtue and Co., Ltd.

HALL, T. C. F. Lead ores. (Imperial Institute Monograph on Mineral Resources.) London 1921. pp. x + 127. ill. 6*s*. net. (*Recd.* 30/3/21.) From the Director.

MACDOUGALL, FRANK HENRY. Thermodynamics and chemistry. New York 1921. pp. vi + 391. ill. $5.50 net. (*Recd.* 7/4/21.)
From the Publishers: Messrs. J. Wiley and Sons, Inc.

REDGROVE, HERBERT STANLEY. Roger Bacon: the father of experimental science and mediæval occultism. London 1920. pp. 63. ill. (*Recd.* 7/4/21.) From the Author.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN. Photographic Abstracts. Vol. I, etc. London 1921 +. (*Reference.*)
From the Society.

RUMBOLD, W. G. Chromium ore. (Imperial Institute Monograph on Mineral Resources.) London 1921. pp. x + 58. 3*s.* 6*d.* net. (*Recd.* 7/4/21.) From the Director.

II. *By Purchase.*

AUSTERWEIL, GEZA, and ROTH, JULIUS. Gewinnung und Verarbeitung von Harz und Harzprodukten. München 1917. pp. vi + 180. ill. (*Recd.* 15/3/21.)

HASSE, PAUL. Laboratoriumsbuch für die Weinuntersuchung: eine Einführung in die Hauptabschnitte der Weinprüfung. Halle (Saale) 1920. pp. vi + 132. ill. (*Recd.* 5/4/21.)

III. *Pamphlets.*

GROENEWEGE, J. The nitrosoindol test. (From the *Med. Geneesk. Lab., Weltevreden*, 1919 [iii], *A.*)

IMPERIAL MINERAL RESOURCES BUREAU. The Mineral Industry of the British Empire and Foreign Countries. War Period. Aluminium and bauxite. (1913–1919.) London 1921. pp. 36.

—— —— Zinc. (1913–1919.) London 1921. pp. 112.

OSTERHOUT, WINTHROP JOHN VANLEUVEN. On the nature of antagonism. (From *Science*, 1915, N.S. **41**.)

—— Eduard Strasburger (1844–1912). (From the *Proc. Amer. Acad. Arts and Sci.*, 1916, **51**.)

—— Tolerance of fresh water by marine plants and its relation to adaptation. (From the *Bot. Gaz.*, 1917, **63**.)

—— The rôle of the nucleus in oxidation. (From *Science*, 1917, N.S., **46**.)

—— Endurance of extreme conditions and its relation to the theory of adaptation. (From the *Amer. J. Bot.*, 1918, **5**.) ill.

—— The nucleus as a center of oxidation. (From the *Brooklyn Bot. Garden Mem.*, 1918, **1**.)

—— Note on measuring the relative rates of life processes. (From *Science*, 1918, **48**.)

PUSA, AGRICULTURAL RESEARCH INSTITUTE. *Indigo Publication No.* **8**. Note on the development of the indigo industry in Assam in conjunction with tea and other crops. By WILLIAM ALFRED DAVIS. Calcutta 1921. pp. 17.

REINITZER, FRIEDRICH. Vorkommen und Gewinnung der Kautschukmilch. (From the *Mitt. Nat. Vereines Steiermark*, 1916, **53**.)

SCIENTIFIC AND INDUSTRIAL RESEARCH, Department of. *Fuel Research Board.* Technical Paper No. 2. Report on the Simmance total heat recording calorimeter. By THOMAS GRAY and ALFRED BLACKIE. London 1921. pp. 23.

TIZARD, HENRY THOMAS, and PYE, D. R. The character of various fuels for internal combustion engines: the influences of specific heat and dissociation of the working fluid. (From the *Automobile Engineer*, 1921.) ill.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE BALLOT TO BE HELD AT THE ORDINARY SCIENTIFIC MEETING ON THURSDAY, MAY 5TH, 1921.

N.B.—The names of those who sign from " General Knowledge " are printed in *italics*.

ABREY, GERALD MORRIS, Tudor Lodge, Bath Road, Slough. Assayer and Analytical Chemist. Articled to Mr. Benedict Kitto, F.I.C., F.G.S., etc., for three years, Sept. 1910 till 1913, and then employed as an assistant till present time; engaged in the analysis and assay of the rare and common metals and their ores; the analysis of foods, waters, and sewage; introducing various modifications and new methods of analysis from time to time. (*Signed by*) William Kitto, Ben. T. Kitto, H. W. Hutchin, *C. G. Moor, William G. Wagner.*

ANDERSON, JOHN HENRY, Botany Cottage, Purfleet, Essex. Works Manager, Wm. Cory & Son, Ltd. (Steamship Owners' Coal Assoc., Ltd., branch), M. Inst. Mining E.,M. Inst. Pet. Tech., M.I. Mar.E., A. M.I. Mech. E. (Soc. Chem. Ind.). 1st prize Mining Chemistry, Larkhall Academy, Lanarkshire, N.B., 1889. Denny Gold Medallist, session 1919–20. Private research work utilisation of fuels, mixing, blending, and economic use of. Author of " Economic Use of Coal," " Winning and Preparation of Coal," " Transport and Handling of Coal." Private research work on " Spontaneous Ignition of Coal." Author of " Storage of Coal, with its relation to spontaneous ignition of heaps, cargoes, and bunkers." Also several lectures given on coal and its general uses from an economic point, prepared and given by me, at the request of Chief Technical Adviser to Coal Controller. Research work for ferro-concrete, oxidation of steel, and cause of cracking, methods preventing occurrence of same, also how to efficiently repair same. (*Signed by*) Tom M. McKenzie, N. A. Anfilogoff, A. E. Carey.

Bell, Arthur George, Hazel House, Dovecot Street, Stockton-on-Tees. Analytical Chemist. For the past eight years chief assistant chemist, in charge of laboratory of the Carlton Iron Co., Ltd., Stillington, Ferryhill; lecturer in iron and steel manufacture at High School Evening Classes, Middlesbrough, 1919–20 and 1920–21. (*Signed by*) T. Lambert, N. D Ridsdale, J. G. Taylor, J. W. Patterson.

Bennison, William, 2, Shawfield Street, Chelsea, London, S.W.3. Works Chemist to Monastère Liqueurs, Ltd., Chelsea. Lecturer on botany and demonstrator in practical chemistry at the London College of Pharmacy in 1911–12, under Henry Wooton, B.Sc. Studied chemistry at the Pharmaceutical College, Bloomsbury Square, London, 1909–11, under Dr. A. W. Crossley; continued these studies at King's College under Prof. Jackson; passed the final examination of the Pharmaceutical Society of Great Britain in 1910, the subjects including analytical chemistry and physics; passed major examination of the Pharmaceutical Society in 1911. Analytical research chemist in charge of the laboratories of Messrs. The W. E. Blake Explosive Co., Ltd. (contractors to H.M. Government). Advisory chemist to Monastère Liqueurs, Ltd. (*Signed by*) Percy Barrs, C. H. Hampshire, J. Wicliffe Peck, G. F. Morrell, Sydney Smith.

Billett, Arthur William, 7, Sunnybank, Lyncombe Vale, Bath. Student, University of Bristol. I wish to keep in touch with latest developments in chemistry, to aid me in my researches after leaving the university, and to gain access to means of reference to past work in chemistry. (*Signed by*) F. W. Rixon, J. W. McBain, F. Francis, B. Fullman, M. Taylor.

Birch, Stanley Francis, 28, Marloes Road, Kensington, London, W.8. Research Student at the Royal College of Science. A.R.C.S., B.Sc. (Hons.). At present engaged on organic research under Prof. J. F. Thorpe, F.R.S. (*Signed by*) Jocelyn Thorpe, James C. Philip, C. K. Ingold.

Boyle, Mary, Royal Holloway College, Englefield Green, Surrey. Lecturer on Chemistry at the Royal Holloway College. D.Sc., London. Papers in the Chem. Society's Journal on (1) Iodobenzenesulphonic Acids; (2) Conductivities of Iodoanilinesulphonic Acids. (*Signed by*) M. A. Whiteley, James C. Philip, W. P. Wynne, T. S. Moore.

Brice, Frederick Stanley Winston, 46, Hamilton Road, Felixstowe. Student, training for B.Sc. Hons. Chem. at King's College, University of London. (*Signed by*) Samuel Smiles, H. W. Cremer, Arthur Fairbourne.

Caden, Robert, 32, Whitburn Street, West Hartlepool. Chief Assistant Metallurgical Chemist, South Durham Steel & Iron Co., W. Hartlepool. Chief assistant chemist. I hold a final certificate in metallurgy of iron and steel, of City and Guilds of London Institute, and I wish to obtain the Journal to assist me in my work. (*Signed by*) J. W. Patterson, Gilbert Palmer, Geo. B. Butler.

Crewdson, Mary Sumner, 50, Southwood Lane, Highgate, N.6. Assistant Lecturer, Dept. of Inorganic and Physical Chemistry, Bedford College, University of London. Student, Bedford College, 1907–10; 2nd Class Hons. in chemistry, 1910; science teacher, 1911–18; demonstrator, Bedford College, 1918–19; asst. lecturer, Bedford College, 1920—. Paper in *J.C.S.* with Dr. Spencer, 1908, "The Direct Interaction of Alkyl Halides with Magnesium." (*Signed by*) Holland Crompton, J. F. Spencer, Arthur J. Chapman.

Dancaster, Ernest Augustus, 101 Merton Hall Road, Wimbledon, S.W.19. Chemist and Metallurgist, Engineers' Department, London & South-Western Railway. B.Sc. (honours in chemistry), London. A.I.C. Author of "Limes and Cements," published by Messrs. Crosby, Lockwood

and Son. Joint author (with Dr. G. Martin) of "The Halogens and their Allies" (being Vol. VIII of "A Text-book of Inorganic Chemistry," edited by Dr. Newton Friend), published by Messrs. C. Griffin & Co. Author of sections on "The Illuminating Gases Industry" and "Calcareous Cements" in Dr. G. Martin's "Industrial Chemistry," published by Messrs. Crosby, Lockwood & Son. Evening research student at Birkbeck College. (*Signed by*) Alex. McKenzie, F. Barrow, F. J. Thorneycroft, George Senter, F. B. Thole.

Das, Hridi Ranjan, M.Sc., Canning College, Lucknow, India. Professor of Chemistry, Canning College, Lucknow, India. Passed B.Sc. (Hons.) in chemistry and M.Sc. (chemistry) from University of Calcutta. Research work, "Condensation of Alcohols with Chloro-urethanes," submitted to the University of Calcutta. At present carrying on work on vegetable oil produced in India. Served for some time as a chemist to Messrs. Steel Bros. and Co., Rangoon; The Rangoon Pharmaceutical and Chemical Works, Rangoon; the Bengal Chemical and Pharmaceutical Works, Calcutta. At present professor of organic chemistry, Canning College, Lucknow. (*Signed by*) J. N. Rakshit, R. L. Datta, P. Neogi, A. C. Sircar, Chuni Lal Bose.

Davies, Harry Clinton, 83, Darlaston Road, Walsall. Industrial Chemist. Assistant on chemical staff of the Dunlop Rubber Co., Ltd.; student; attempted research on colour photography for production of direct colour prints. (*Signed by*) J. Newton Friend, John H. Lavender, Harry Berry.

Davis, Archibald Arthur, "Rochdale," 1, King's Road, Henley-on-Thames. Student of Chemistry. In training for the minor and major examinations of the Pharmaceutical Society, with a view of taking the B.Sc. (Lond.) eventually. I wish to receive the Journal and have the use of the library. (*Signed by*) H. Bassett, J. W. Dodgson, Cecil H. Cribb.

Dawson, Edward Lionel, 28, Norreys Street, Rochdale, Lancs. Works Chemist (assist.). Five years' study of chemistry, two at the College of Technology, Manchester; over four years in works laboratory doing general analytical work. (*Signed by*) Frank Lee Pyman, R. Lindsay Grant, Jas. Grant.

Dean, Harry Fitz-Gibbon, 57, Ashley Road, Bristol. Research in Organic Chemistry with Dr. Nierenstein, and Chemist to the St. Anne's Board Mill Co., Ltd., Bristol. M.Sc. (Bristol), A.I.C. (*Signed by*) M. Taylor, F. Francis, F. W. Rixon, J. W. McBain, M. Nierenstein.

Edwards, Percy, 12, Parkfield Road, New Moston, Manchester. Analytical Chemist. I am the chief assistant in the laboratory of the Manchester Chamber of Commerce Testing House. I desire to join the Chemical Society in order to keep up to date with chemical developments. (*Signed by*) Alfred Holt, W. R. Ormandy, Samuel M. Walford, Fred. W. Barwick, *H. F. Coward.*

Ellison, Charles Ottley, "Elmfield," Headingley, Leeds. Third-year Student in Pure Chemistry at University of Leeds. Studying for Hons. B.Sc. in 1922. (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson, W. Lowson, M. S. Leslie.

Everett, Charles William, 3, Compton Street, Brunswick Square, London, W.C.1. Assistant Science Master. Rutlish School, Merton.. Associate College of Preceptors (Honours Chemistry); Board of Education Prelim. Certif. Teacher; student of science, Birkbeck College, University of London. (*Signed by*) A. V. C. Fenby, Samuel Sugden, F. Barrow, F. B. Thole.

Farnell, Gladys, The Penn Club, 8, 9, 10, Tavistock Square, W.C.1.

Research Work in Organic Chemistry at Bedford College. B.Sc., pass, 1st Class, London, chemistry, physics, physiology, 1916; assistant lecturer in chemistry, Battersea Polytechnic, 1917–18; assistant lecturer in chemistry, University College, Reading, 1918–19; B.Sc., Honours chemistry, 1st Class, London, 1920. (*Signed by*) Holland Crompton, J. F. Spencer, J. Kenner.

FERRIER, GEORGE STRATON, 10, Hamilton Park Terrace, Hillhead, Glasgow. Student. A third-year student of chemistry at the Royal Technical College, Glasgow. Desirous of reading the results of recent research as given in the papers and abstracts in the Journal of the Chemical Society. (*Signed by*) F. J. Wilson, R. M. Caven, G. G. Henderson, Thomas Gray, Frank W. Young.

FOORD, ALFRED JAMES, 98, Fleet Road, Hampstead, N.W.3. Preparer. Employed in the Scientific and Technical Department, Imperial Institute (five years), and studying in the Scientific Department at the Northern Polytechnic Institute in evenings. Desirous of having the Society's literature and keeping in touch with modern chemical development. (*Signed by*) Raymond R. Butler, Frederic Ferraboschi, H. T. Islip, T. J. Drakeley, Thos. McLachlan.

FRY, VICTOR ERIC, Royal Hotel, Glasgow. University Undergraduate. Student at Royal Technical College, Glasgow, for degree of B.Sc. in Applied Chemistry and Associateship of Royal Technical College, with a view to following the profession of applied chemistry. (*Signed by*) F. J. Wilson, R. M. Caven, Thomas Gray.

GHOSE, SUDHINDRA NATH, 15, Provost Road, London, N.W.3. Research Student. Student under Sir P. C. Rây, D.Sc. (Edin.), F.C.S., for three years; worked under Prof. B. B. Dey, D.Sc. (Lond.), F.C.S., for two years; graduated in 1920 as a B.Sc. of Calcutta, with Hons. in chemistry. Now a research student in the University College, London, studying for the Ph.D. degree of the London University in biological chemistry. (*Signed by*) J. C. Drummond, S. S. Bhatnagar, J. C. Ghosh, J. N. Mukherjee.

GIBSON, DAVID TEMPLETON, Altamont, Bangor, Co. Down. Research Student. B.Sc. chemistry (Hons.). Paper submitted for publication in Transactions. (*Signed by*) A. W. Stewart, A. Killen Macbeth, H. Graham.

GOTT, HERBERT, 14, Fell Croft, Dalton-in-Furness, Lancashire. Student, Leeds University; final year. Honours chemistry course. (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson.

GREEN, WILLIAM, South Parade, Northallerton, Yorks. Chemical Ceramic Engineer. Design of Chemical Plant. Research Work, Methods of Manufacture. Specialising in ceramic ware used in the chemical industry, laboratory and constructional. Formerly technical adviser and ceramic expert (chemical pottery and refractories), Headquarters Technical Staff. Department of Explosives Supplies, Ministry of Munitions, Storey's Gate, London. Specialist de la Ceramique, French Ministry of War. Technical adviser on chemical pottery and plant for the Nitrogen Products & Carbide Co., Ltd. At present: Technical adviser and representative to: Messrs. Shanks & Co., Ltd., Barrhead, Scotland, chemical ware manufacturers, laboratory and constructional; Messrs. Boving & Co., Ltd., Kingsway, London, W.C.2, wood pulp chemical engineers; Messrs. Statham & Sons, Manchester, acid-resisting materials; Messrs. James Oakes & Co., Alfreton, acid-resisting materials; Messrs. Withnell Co., Ltd., Withnell, acid-resisting materials; and others. (*Signed by*) W. Beamont Hart, C. Davidson, J. W. Mellor, R. B. Forster, E. F. Armstrong, F. Mollwo Perkin.

GREENHAM, JOHN, Bedford, Halifax, Nova Scotia, Canada. Analytical

Chemist. Five years junior assistant to the late R. Barklie, Esq., F.C.S. Public analyst for city of Belfast, etc.; three years analyst for the Antrim Iron Ore Co., Ltd., Belfast; nine years assistant to Charles McMullan, Esq., F.I.C., public analyst for counties of Donegal, Longford, etc., 7, William Street, South Belfast, Ireland. At present analyst and bacteriologist to the Scotia Pure Milk Co., Ltd., Halifax, N.S. Canada. (*Signed by*) Theophilus Harper, Robt. F. Blake, John Montgomery.

Harris, Alfred Norman, "Bramley," Haugh Road, Walmer, Port Elizabeth, S. Africa. Chemist. Manager of Pharmaceutical Laboratory, employed in manufacturing, together with assay of crude drugs and galenicals and general analytical processes. (*Signed by*) Geo. W. Howard, T. E. Wallis, H. Lucas.

Harrison, Douglas Frank, 19, Woburn Square, London, W.C.1. Undergraduate of King's College, Cambridge. I am at present reading for the Natural Science Tripos, Part I, which I shall take in June, 1921. I hope to take Chemistry, Part II, in June, 1922. (*Signed by*) Charles T. Heycock, W. J. Pope, Hamilton McCombie.

Harry, Reginald Herman Roland, Apartado 42, Bilbao, Spain. Analytical Chemist. One year with Messrs. Harry, Dougall & Co., of Maryport, Cumberland; about three months with Messrs. R. W. & A. J. Atkinson, of 10, North Church Street, Cardiff; six years assistant chemist to James A. Allison, Esq., Apartado 45, Bilbao, Spain; two and a half years works chemist to Messrs. Eduardo K. Earle y Cia, Brass Founders, Apartado 60, Bilbao, Spain. At present chief chemist to Messrs. The Orconera Iron Ore Co. (*Signed by*) Alf. R. Campbell, James A. Allison, R. W. Atkinson, Alex. W. McLaren.

Hawkes, William Henry, 42, Great Sutton Street, Goswell Road, London, E.C.1. Analytical Chemist. Two years Technical Chemistry Dept., Northampton Polytechnic Inst., London, E.C.1; three years research chemist, British Metals Extraction Co., Swansea, S. Wales. Present occupation: with B. Kitto, Esq., Public Analyst, 366, City Road, London, E.C.1. (*Signed by*) R. Mullineux Walmsley, Samuel Field, A. H. Mundey, William Kitto, Ben. T. Kitto.

Hulls, Leonard George, c/o Messrs. Peek, Frean & Co., Ltd., Drummond Road, Bermondsey, S.E.16. Chemist. General Works, Chemistry and Bacteriology. Experimental and analytical chemist; original work still in progress on a chemical elaboration of the Wassermann blood test. Three years' work in France during the war: preparation of mercury organic compounds for treatment of venereal disease; detection of arsenic and mercury in organs of bodies (mentioned in R.A.M.C. Journal). Chemistry in connexion with bacteriology, etc. (*Signed by*) R. Whymper, A. H. Salway, Harold King.

Jenkes, Reginald William, 17, Braydon Road, Stamford Hill, N.16. Third-year Student at East London College. Passed External Intermediate B.Sc. Examination, 1913, and studying for Honours Chemistry B.Sc. Examination, 1921. (*Signed by*) J. R. Partington, F. G. Pope, James Taylor.

Jennings, James Sowden, 5, Portland Villas, Bath Street, Dewsbury, Yorkshire. Student, reading for final examination for degree of B.Sc. Chemistry, June 1921. (*Signed by*) W. Lowson, J. B. Cohen, Arthur Smithells.

Johnson, Thomas Henry, 16, Framfield Road, Highbury, N.5. Lecturer and Demonstrator in Technical Chemistry, Northampton Polytechnic Institute, St. John Street, Clerkenwell, E.C.1. Five years chief metallurgist, Aerators,

Ltd., Edmonton. M. Inst. Met. (*Signed by*) R. Mullineux Walmsley, Samuel Field, A. H. Mundey.

JOINER, ERIC MILLWARD, 17, Loyells Street, Birmingham. Lecturer at Handsworth Technical School. Student at Birmingham University, 1917–20 (Chemistry); lecturer on chemistry, etc., at Handsworth Technical School, 1920– ; demonstrator in chemistry, Aston Technical School (evening), 1917–20. (*Signed by*) H. Gordon Reeves, S. R. Carter, C. E. Wood, Wm. Wardlaw.

KAY, WILLIAM WHITTLE, 133, Lee Lane, Horwich, near Bolton. Chemist. B.Sc. (Honours Chemistry), Manchester; chief chemist, hydrosulphite products plant at Messrs. Brotherton & Co.'s, Port Rainbow, Cheshire. (*Signed by*) R. W. Merriman, Ernest G. Gaul, Henry Stephen.

KINKEAD, ROBERT WILLIAM, Hollymount, Osborne Park, Belfast. Research Student. B.Sc. (chemistry main); published an article in *Chemical News*, Jan. 7, 1921. (*Signed by*) A. W. Stewart, A. Killen Macbeth, H. Graham.

KITCHEN, ERNEST DAVID, 50, Edensor Road, Keighley. Trained Certificated Schoolmaster. Inter. B.Sc. (London), 1914; final year B.Sc. (Leeds). (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson.

LAWTON, GEORGE, 3, Eldroth Road, Savile Park, Halifax, Yorks. Chemist, Campbell Gas Engine Co., Ltd., Kingston, Halifax. B.Sc., London, Honours in Chemistry. (*Signed by*) Arthur Bramley, James Bruce, Arthur S. Wood, W. J. Stansfield, H. H. Gray.

LEAVER, CHARLES, "Hope House," Winkfield, Windsor. Student at University College, London. Reading for B.Sc. (Hons. Chemistry) degree (London). He is very anxious to keep up-to-date in all developments of the science, and to be allowed the privilege of using the library. (*Signed by*) Morris W. Travers, Irvine Masson, J. N. E. Day.

LE PLA, MARGARET, 35, Villiers Road, Southall, Middlesex. Indexer to the Chemical Society's publications. B.Sc. (Lond.); editorial and research assistant to (the late) Dr. J. C. Cain, 1910–21; formerly demonstrator and research assistant at Bedford College, London. Joint author with Dr. J. F. Spencer of the following papers: (i) "Quantitative Separation of Thallium from Silver" (Trans. C.S., 1908); (ii) "Eine Elektrode zur Messung der Konzentration der CO_3''-Ionen und der Zustand des Silbercarbonats in Lösung" (*Zeitsch. anorg. Chem.*, 1909, 65). (*Signed by*) M. O. Forster, H. R. Le Sueur, John Greenaway, Clarence Smith, J. F. Spencer.

LIVERMORE, FRANK ALFRED WILLIAM, 94, Bankes Road, Small Heath, Birmingham. Assistant Works Manager of Messrs. Lavender & Whitehouse, Wednesbury, metallurgists and heat-treatment specialists and founders. B.Sc. (Lond.); four years works chemist at Birmingham Metal & Munitions Co., Ltd.; three years assistant to Mr. C. Leigh, F.I.C., F.C.S.; two years assistant to Mr. L. Thomas, B.Sc., F.I.C.; consulting chemist; lecturer in chemistry, Staffs County College, Wednesbury (intermediate). (*Signed by*) Cecil Leigh, Samuel Lamb, J. Newton Friend.

MCEWEN, BASIL CHARLES, H.E.H. The Nizam's College, Hyderabád, Deccan, India. Science Professor, His Exalted Highness the Nizam's College, Hyderabád, Deccan, India. B.Sc. (1st Honours), London (chemistry). Science professor, H.E.H. the Nizam's College, Hyderabád, since 1909 (excepting four and a half years' war service); analyst to H.E.H. the Nizam's Government, and assayer to H.E.H. the Nizam's Mint. Published joint paper in the Transactions of the Chemical Society (1908, vol. 93, p. 1000 *et seq.*) on "The Mutual Solubility of 2-Methylpiperidine and Water." (*Signed by*) J. N. Collie, B. D. Porritt, F. G. Donnan, Samuel Smiles, W. B. Tuck.

MACKIE, HENRY BROWN, 5, Balfour Road, Brighton. Lecturer in Pharmaceutics, Municipal Technical College, Brighton. Member Pharmaceutical Society, M.P.S.; pharmaceutical chemist, Ph.C.; seven years pharmacist, St. Thomas Hospital, London. (*Signed by*) W. W. Reeve, M. C. Clutterbuck, D. Ridge.

MAITRA, JOGENDRA NATH, B.Sc., 58A, Colootola Street, Calcutta (India). Research Scholar and formerly Laboratory Assistant in the Presidency College. I was an assistant in chemical physiology in the Presidency College, and isolated picrates of dimethyl- and trimethyl-amines, the odoriferous body in Hilsa fish found in some Indian rivers, and determined some "Nutritive Principles in some Indian Foodstuffs," which constitutes a thesis which was submitted in an All-Indian competition. (*Signed by*) T. N. Majumdar, S. N. De, U. N. Ray Chowdhuri, T. K. Ghose.

MANDELL, JOHN, 12, Campden Hill Gardens, Kensington, W.8. Chemist. Training: East London College (session 1916–17, part session 1917–18); School of the Pharmaceutical Society (session 1919–20). Member of the Pharmaceutical Society. Continuing chemistry training. Wish to receive publications of Chemical Society, and have access to library. (*Signed by*) I. Sklar, S. Mellins, J. Tavroges, *A. Houssa, H. Hunter.*

MANSURI, QASIM ALI, M.Sc., 18, Hartington Grove, Cambridge. Research Scholar, Muslim University of Aligarh (India), at present engaged in research in the Cambridge University. M.Sc. in chemistry of the Punjab University (India); was demonstrator in F.C. College, Lahore (India); professor of science, Islamia College, Peshawar; and lecturer demonstrator in the Chemical and Metallurgical Department of C.E. College, Calcutta; have done considerable research work. (*Signed by*) Charles T. Heycock, R. H. Atkinson, S. N. Dhar.

MEHTA, MANECK MERWANJI, 116, Grosvenor Road, Highbury, London, N.5. Government of India Scholar (Research Student). M.A., M.Sc. (Bombay), A.I.I.Sc. (Bangalore); lecturer in physics and chemistry, Lady Hardinge Medical College, Delhi. Co-author with Dr. J. J. Sudborough of "Perishing of Paper in Indian Libraries," Journal of Indian Institute of Science. (*Signed by*) James C. Philip, M. A. Whiteley, K. G. Naik, Eric Sinkinson.

MILNE, LESLIE BURT, 27, Warren Road, Wanstead, London, E.11. Works Chemist, Messrs. Loders & Nucoline, Ltd., Seed Crushers and Edible Oil Refiners, Hammersmith. Internal student (undergraduate) of the University of London; Faculty of Science at the South-Western Polytechnic Institute. Matriculated January, 1920; sitting for inter-science examination, July, 1921. (*Signed by*) E. R. Bolton, J. B. Coleman, J. C. Crocker.

MOLESWORTH, JOHN DAVENPORT NEWALL, Balcombe, Sussex. Employed on Technical Staff (civilian capacity), War Office, Whitehall, S.W.1. I am anxious to keep up-to-date in chemical research, especially in connexion with metals. Studied at the College of Technology, Manchester, for three years in the subject of brewing, during 1903–4–5; in the latter year obtained the Hons. Certif. of the City and Guilds in brewing. In the following year went to Selangor, Fed. Malay States, as a sugar chemist; afterwards added rubber production to the estate. Came home to join up in the Great War and obtained my lieut.-colonelcy. (*Signed by*) Edmund Knecht, Jas. Grant, E. L. Rhead, F. S. Sinnatt, *John K. Wood.*

MOTTRAM, SYDNEY WM. ROYLE, 178, Lloyd Street, Moss Side, Manchester. Certificated Teacher, Ducie Avenue Municipal School, Manchester. I am a fully qualified teacher, keenly interested in chemical research, and am in

my final year for the associateship of the Manchester College of Technology, which I hope to obtain in May, 1921. I have had ten years' teaching experience in general science, including chemistry, at the Ducie Avenue Municipal School, Manchester, and am privately engaged in spectroscopical research. I am a member of the Manchester Astronomical Society, and have also been nominated for the Manchester Radio Scientific Society. I am also taking up research in photographic chemistry. (*Signed by*) John Allan, Frank Lee Pyman, John K. Wood.

MURDOCH, DONALD GEORGE, 26, Olive Road, Cricklewood, N.W.2. Chemist in charge of Technical Laboratory, Research Dept., Tar & Ammonia Products Works, Beckton. B.Sc. (1st Class Hons., Lond., 1920); A.C.G.F.C. (Diploma, City and Guilds Technical College, Finsbury); Streatfeild Memorial Prize. 1920 (practical chemistry); evening research student (pure organic chemistry), (*Signed by*) G. T. Morgan, A. J. Hale, H. M. Atkinson.

NANCE, JOHN TRENGOVE, 9, Green Bank Drive, Sefton Park, Liverpool. Assistant Lecturer and Demonstrator in Chemistry, Liverpool University. M.A., Oxford. (*Signed by*) E. C. C. Baly, F. C. Guthrie, L. W. Codd.

NATHAN, COLONEL SIR FREDERIC LEWIS, K.B.E., 37, Cornwall Gardens, S.W.7. Author of numerous contributions to the literature of explosives, and originator of many manufacturing processes employed in the explosives industry. (*Signed by*) James J. Dobbie, Robert Robertson, Henry E. Armstrong, Arthur W. Crossley.

PAWLEY, GEORGE CHARLES, Crampton Street School, Newington Butts, S.E.17. Student at East London College. I am an Honours student in chemistry at East London College, and I am in my third year, intending to do research next year. (*Signed by*) J. R. Partington, F. G. Pope, F. F. Peet.

PAWSEY, EDITH HILDA, 4, Parade Mansions, Coldharbour Lane, Camberwell, S.E.5. Assistant Research Chemist. B.Sc. (Honours), A.I.C.; assistant research chemist at the South Metropolitan Gas Co. (*Signed by*) Eunice A. Bucknell, William Barr, Vernon P. Hart.

POPE, CLIFFORD GEORGE, 18, Cowper Street, Redfield, Bristol. Student in Chemistry. (*Signed by*) M. Taylor, F. Francis, F. W. Rixon, J. W. McBain, M. Nierenstein.

PORTER, JOHN GUY, St. Mary's Street, Ely, Cambs. Science Master, King's School, Ely. Inter. B.Sc. (1st Honours, London). With a view to future research, am desirous of joining in order to keep in touch with modern progress in physical chemistry. (*Signed by*) Thos. J. Kirkland, A. de Waele, Dudley Ridge.

POULSON, THOMAS HENRY, Bull Hill, Stafford. Engineer and Manager, The Corporation Gas Department, Stafford. 1st Class Honours grade inorganic chemistry, theoretical; 2nd Class Honours grade inorganic chemistry, practical (City and Guilds examinations). Experience includes: charge of five gas works, carbonising coal and oil and treating residual products, including the manufacture of sulphate of ammonia, benzol, etc.; the design and erection of various large chemical plants and control of gas works, physical and chemical laboratories; developed successful process for use of nitre cake in sulphate of ammonia manufacture; also process for manufacture of neutral dry sulphate of ammonia. Associate Member Institution of Mechanical Engineers; Associate Member Institution of Gas Engineers. (*Signed by*) R. J. Milbourne, A. V. Hendrickson, L. A. Rumble.

RASMUSSEN, HANS THORNING BAGGESGAARD, Chemical Laboratory of University, 5, Østervoldgade, Copenhagen, K. Denmark. Assistant Lecturer

in Organic Chemistry. (*Signed by*) M. O. Forster, Jocelyn Thorpe, Chr. Winther.

Read, William John, 71, Northgate, Wakefield. Chief Chemist to West Riding of Yorkshire Rivers Board. M.Sc. (Manchester), F.I.C. (by examination). Now acting as above; previously public analyst and bacteriologist to the county of Somerset. (*Signed by*) H. T. Calvert, Charles H. Bothamley, Walter Leach.

Rhodes, Edgar, Cross House, East Bierley, nr. Bradford. Student, Leeds University. Studying for B.Sc. Hons. (*Signed by*) Arthur Smithells, H. M. Dawson, J. B. Cohen, W. Lowson, M. S. Leslie.

Roberts, Elwyn, 3, Mostyn Terrace, Bethesda, North Wales. Research Student. Two years chemist at Kynoch's, Ltd., Arklow, Ireland, 1916–18; one year chemist at Nobel's, Pembrey, S. Wales, 1918–19; B.Sc. (Wales), 1st Class Honours chemistry, 1920. (*Signed by*) Kennedy P. Orton, H. B. Watson, Frederick Soper, I. Cheer Roberts.

Robinson, Harold Edmund, 146, Platt Lane, Rusholme, Manchester. Analytical Chemist. One and a half years as 1st assistant analyst, James Woolleys, Sons & Co., Manchester; at present, analyst at A. O. Ferguson, Hollinwood, nr. Manchester; fourth-year student at Manchester College of Technology (course, general chemical technology). (*Signed by*) Frank Lee Pyman, R. Lindsay Grant, John K. Wood.

Rogers, Cecil William, Roding Villa, Maybank Road, South Woodford, Essex. Teacher, Preston Grammar School, Preston, Lancs. 2nd Class Honours in B.Sc. (Lond.), 1920; teacher of chemistry. (*Signed by*) J. R. Partington, F. G. Pope, James Taylor.

Rumsey, George Raymond, High Street, Hornchurch, Romford, Essex. Schoolmaster. B.Sc. (Lond), 1st Class Honours chemistry, 1920; science master, Parmiter's Foundation School, Approach Road, E.2., 1920–present date. (*Signed by*) F. G. Pope, J. R. Partington, S. H. Woolhouse.

Sarin, Jiwan Lal, Batala (Panjab, India). Industrial Surveyor (Dept. of Industries, Panjab), Sialkot City (India). (1) B.Sc. with Honours, year 1918, Panjab University; (2) M.Sc. (chemistry), 1st Class, 1920, Panjab University; (3) research on "Relation between Chemical Constitution and Optical Rotatory Power," "Derivatives of Diphenylenetriamino- and Amino-Camphor"; (4) demonstrator for two years, Government College, Lahore. (*Signed by*) Edwin Theodore Dean, N. A. Yajnik, S. R. Khosla.

Scott, John Richard, 12, Roundhay Crescent, Harehills Lane, Leeds. Student. Student at Leeds University since 1917; at present reading for the final examination for B.Sc. (with Honours in chemistry); engaged on research in organic chemistry under the direction of Prof. Cohen. (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson, W. Lowson, P. K. Dutt.

Silverberg, Harold, 187, Victoria Park Road, South Hackney, E.9. Works Chemist. B.Sc. (Honours chemistry), London University. I have been a works research chemist for the past two and a half years, and desire to keep in touch with the development of chemistry. (*Signed by*) Charles A. Keane, Henry J. S. Sand, George White, Otto Oberländer.

Smith, Henry Edward, Oakdene Villas, South Street, Cottingham, nr. Hull. Works Chemist. Indentured with Messrs. W. H. Holmes & Sons, Newcastle-on-Tyne, and was with them from 1891 to 1899; with Thos. Hinshelwood & Co., Glasgow, from 1899–1905, as chemist and departmental manager; with Messrs. J. W. & T. A. Smith, Old Ford, London, E., 1906–14, as colour dept. manager; from 1915 to date with Messrs. Raines & Porter,

E. Hull, as colour chemist and debartmental manager. (*Signed by*) Harry Thompson, W. Geary, Thos. A. Nightscales.

SMITH, JOHN, 31, Dempster Street, Greenock. Demonstrator in Chemistry, Edinburgh University. B.Sc. degree in applied chemistry (organic side) of Glasgow University (Nov. 1919). Elected A.I.C. (Jan. 1920). Demonstrator in chemistry, Glasgow (one year), then Edinburgh. (*Signed by*) James Walker, Leonard Dobbin, Sydney A. Kay.

SMITH, PERCY HARRY, 24, Hamilton Road, Ilford, Essex. Analytical Chemist. Final year of Honours graduate course, Birkbeck College; eight years works analytical experience. (*Signed by*) Reginald G. Halstead, Samuel Sugden, E. D. Griffiths, F. J. Thorneycroft, F. Barrow.

SOWDEN, WILLIE, Fernleigh, 48, High Street, Cleckheaton. Chemical Engineer. B.Sc. (chemistry), Leeds; chemist under Ministry of Munitions, testing coal tars and explosives; chemist in charge of manufacture of picric acid; now engaged on problems and plant with special regard to recovery of waste products. (*Signed by*) J. B. Cohen, H. M. Dawson, W. Lowson.

SPIERS, CHARLES WILLIAM, 20, Florence Park, Redlands, Bristol. Works Chemist. M.Sc. (Bristol), A.I.C.; research assistant, University Agricultural Research Station, Bristol, 1912–15; works chemist, James Robertson and Sons, Ltd., 1915; chemist at Central Laboratory, B.E.F., France, 1916–19; works chemist, J. S. Fry & Sons, 1919— . Publications: M. Nierenstein and C. W. Spiers: "Über Purpurogallin" (I), B. **46**, 3151, 1913; C. W. Spiers: "The Estimation of Tannin in Cider," *J. Agric. Science*, vol. vi, p. 77, 1914. (*Signed by*) M. Taylor, F. W. Rixon, F. Francis, J. W. McBain, M. Nierenstein.

SPORING, PERCY ARCHIBALD, 78, Warren Street, Fitzroy Square, W.1. Post Graduate Research Student, University College, London. B.Sc., 2nd Class Hons. in chemistry, London, 1920; at present hold 1851 Exhibition Science Research Bursary (1920); engaged in research in physical chemistry lab., University College. (*Signed by* Irvine Masson, F. G. Donnan, S. S. Bhatnagar, W. E. Garner.

STEVENSON, HAROLD, 6, Cranbourne Road, Heaton Moor, Stockport. Works Chemist. Part-time Lecturer in College of Technology, Manchester. Fellow of Institute of Chemistry. Research chemist, H.M. Chiswick Lab., 1916; science master, Sedgebrook Grammar School, 1904–17; lecturer, Grantham Tech. Inst., 1912–15; associate scholar of University College, Nottingham; present post, works chemist, British Dyestuffs Corp., Clayton. (*Signed by*) W. D. Rogers, Leon. E. Vlies, Frank Brinsley, A. D. Heywood, Raymond E. Crowther.

STOAKLEY, FREDERIC JAMES, University Chemical Laboratory. Laboratory Assistant, Chief. Assistant to Prof. Sir W. J. Pope; formerly assistant to Prof. G. D. Liveing, lecturer on chemistry, Cambridge Technical Institute, 1894–99. (*Signed by*) W. J. Pope, Charles T. Heycock, W. H. Mills, T. M. Lowry, Hamilton McCombie.

STOCKDALE, LEONARD MOORE, Station House, Cullingworth, nr. Bradford. Final-year Honours Student, Leeds University. Studying for Honours B.Sc. pure chemistry, 1921. (*Signed by*) Arthur Smithells, H. M. Dawson, J. B. Cohen, W. Lowson, M. S. Leslie.

WARD, JOHN FREDERIC, 50, Elgin Crescent, W.11. Chemist. Chief chemist, the Crookes Laboratories, British Colloids, Ltd., 22, Chenies Street, W.C.1; consulting chemist to Carbon Products, Ltd., Bombay, and English & Foreign Oil Fuels, Ltd. (*Signed by*) Hubert L. Lucking, Archibald Macpherson, James H. Gardiner.

WEEKS, EDWARD JOSEPH, 62, Forest Hill Road, E. Dulwich, S.E.22.

Third year Hons. student in chemistry; taking final in October of the current year, and then proceeding to further research work at East London College. (*Signed by*) J. R. Partington, F. G. Pope, H. Finnemore.

Whitehead, Hugh Robinson, 3, Ebor Place, Hyde Park, Leeds. Student, Leeds University. Studying for B.Sc. (Hons.), chemistry; fourth year engaged on organic research work in collaboration with Mr. P. K. Dutt and Mr. A. Wormall. (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson, P. K. Dutt, W. Lowson.

Wilkinson, Henry Austin, 41, Nun Mill Street, Scarcroft Road, York. Certificated Teacher. Pupil at Science Course, Archbishop Holgate's Grammar School, York, 1908 to 1914; student at St. Paul's College, Cheltenham, 1914–15 (Inter. B.Sc.); chief assistant chemist at Government (R.A.F.) Laboratory at Pont de l'Arche, France, 1917 to 1919: analysis of steels, alloys, fuels, gases (poison), and investigation of metal mixing for anti-friction metals; student at South-Western Polytechnic Institute, 1920–1; teacher, including chemistry, under London County Council at present. Diplomas: (1) Northern Univ. Matric., 1912, including chemistry; (2) London Univ. Matric., 1914, including chemistry; (3) London Univ. Inter B.Sc. degree, including chemistry, 1915. (*Signed by*) J. B. Coleman, F. H. Lowe, F. Arnall.

Wilkinson, Willie Horner, Flush Lodge, Heckmondwike, Yorks. Chemist. In charge of metallurgical laboratory; member of the Institute of Metals, the American Chemical Society, and Society of Chemical Industry. (*Signed by*) R. S. Cahill, C. E. Womersley, Barker North.

Williams, May, 6, Ruskin Close, Meadway, N.W.11. Demonstrator in Chemistry, London School of Medicine for Women. B.Sc. (Lond.), Hons. chemistry. (*Signed by*) Sibyl T. Widdows, J. A. Gardner, T. S. Moore, James C. Philip.

Wilson, Christopher Percy, 8, Rivington Road, Pendleton, Manchester. Chief Assistant, Chemical Laboratory, the Grammar School, Manchester. Six years' practical experience as assistant in the chemical laboratory of Manchester Grammar School; three years as junior, 1911–14; three years as chief assistant, 1918–21. I hold two 1st Class Certificates for preliminary and intermediate chemistry, and have also nearly completed a three years' advanced course in general chemistry at the Manchester College of Technology. (*Signed by*) Francis Jones, John K. Wood, Frank Lee Pyman.

Woodman, Rowland Marcus, 72, Ladypit Lane, Beeston Hill, Leeds. Student, Leeds University. Final year of B.Sc. (Hons. Chem.). (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson, W. Lowson, M. S. Leslie.

Wormall, Arthur, 20, Ashville View, Cardigan Road, Leeds. Student, Leeds University. Studying for Hons. B.Sc. (chemistry), fourth year; engaged in organic research work in collaboration with Mr. P. K. Dutt and Mr. H. R. Whitehead. (*Signed by*) Arthur Smithells, J. B. Cohen, H. M. Dawson, P. K. Dutt, W. Lowson.

Worrell, Stanley Wilson, 43, Winchelsea Road, Tottenham, N.17. Student, reading for B.Sc. (Hons.) at London University College. Desirous of keeping in touch with the developments of chemistry and of using the library. (*Signed by*) J. N. E. Day, O. L. Brady, Henry Terrey.

The following Certificates have been authorised by the Council for presentation to ballot under Bye-Law I (2):

LICHTHARDT, GEORGE HENRY PHILIP, No. 2309 L Street, Sacramento, California, U.S.A. Analytical, Consulting and Forensic Chemist; State Engineer of Tests, State of California, U.S.A; late Chemist for Southern Pacific Railroad Company, Sacramento, California; Graduate University of California, degree Ph.G.; Hamilton College of Law, degree L.L.B.; teacher of industrial sciences, Sacramento Night High School; late City Chemist City of Sacramento (6 years) (*Signed by*) H. V. Arny, F. W. Bunyan.

TALWAR, DINANATH, Dayal Bagh, Agra, U.P., India. Head of the Chemical Laboratory, Dayal Bagh, Agra. B.Sc. (with Honours in chemistry) of the Punjab University; research scholar at the Indian Institute of Science, Bangalore, for about two years; at present the head of the Chemical Laboratory, Dayal Bagh, Agra. (*Signed by*) Horace B. Dunnicliff, Gilbert J. Fowler.

TORRANCE, WILLIAM, Grootfontein Agricultural College, Middleburg (Cape). Chemist. Twelve years metallurgical chemistry; four and a half years agricultural chemistry. (*Signed by*) H. J. Page, E. J. Russell.

WILLIAMS, GUY YANDALL, 468, Elm Avenue, Norman, Okla. Professor of Physical Chemistry, University of Okla. B.A., 1906, M.A. 1910, Oklahoma University; M.S., Chicago University, 1911; Ph.D., Illinois University, 1913; instructor in chemistry, 1906–8; associate professor, 1908–14; professor of physical chemistry, University of Oklahoma, 1914– ; Fellow, University of Illinois, 1911–13. Published, with E. W. Washburn, "A Precision Viscosimeter," *J.A.C.S.*, **35**, 737; and "Viscosities and Conductivities of Aqueous Solutions of Raffinose," *J.A.C.S.*, **35**, 750. "A Scientists' Officers' Reserve Corps," Metallurgical and Chemical Engineer, Oct., 1917. (*Signed by*) Hilton Ira Jones.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, June 3rd, 1920, at 8 p.m.

The CHAIRMAN referred to the loss sustained by the Society, through death, of:

	Elected.
James Parkinson	Nov. 2nd, 1865.

Messrs. R. W. Alloway, W. Brash, J. N. E. Day, J. W. Gilder, and J. H. Pye were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

Samuel Bartol Bratley, 61, Francis Street, Leicester.
David Cardnell, M.Sc., 14, Blair Road, Alexandra Park, Manchester.
Arthur Walter Cox, 670, Romford Road, E.12.
Louis Anderson Fenn, B.Sc., 100, Highgate, Kendal.
Ellen Field, M.Sc., 64, Warrender Park Road Edinburgh.
Austin William Frost, The Level, Brierley Hill.
Frances Mary Hamer, M.Sc., 55, Dartmouth Park Hill, N.W.5.
Edna Elizabeth Holmes, 72, Barmeston Road, Catford, S.E.6.
Mary Johnson, B.A., 6, Beechwood Street, Sunderland.
Norman Veitch Lothian, B.Sc., M.B., Ch.B., R.A.M. School of Hygiene, Blackpool.
Paul Michael Mooney, B.Sc., 1, Khedive Road, Forest Gate, E.7.
Ralph Howard Raine, 278, South Lambeth Road, S.W.8.
William Preston Riley, 240, Gulson Road, Coventry.
Ernest Alfred Wenhaston Shaw, Southview, Cartmel, Lancashire.
Martha Annie Whiteley, M.A., D.Sc., 111, Castelnau, Barnes, S.W.13.

The following papers were read:

"Studies in the camphane series. Part XXXVIII. The cyanohydrazone of camphorquinone." By M. O. FORSTER and W. B. SAVILLE.

"Arsinic acids derived from guaiacol and veratrole." By R. G. FARGHER.

"Diphenylarsenious chloride and cyanide. (Diphenylchloroarsine and diphenylcyanoarsine.)" By G. T. MORGAN and D. C. VINING.

"Organo-derivatives of bismuth. Part III. The preparation of derivatives of quinquevalent bismuth." By F. CHALLENGER and A. E. GODDARD.

"The influence of nitro-groups on the mobility of substituents in the benzene nucleus. Part II. The dinitrotoluenes." By J. KENNER and M. PARKIN.

"The decomposition of nitric esters." By R. C. FARMER.

Ordinary Scientific Meeting, held in the Lecture Hall of the Institution of Mechanical Engineers on Thursday, June 17th, 1920, at 8 p.m., SIR JAMES J. DOBBIE, M.A., D.Sc., F.R.S., President, in the Chair.

The PRESIDENT announced that the Society had lost, through death, the following Fellow:

	Elected.	Died.
Benjamin Owen Jones	Dec. 5th, 1907.	May 27th, 1920.

Messrs. W. Barr and L. D. Goldsmith were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

Wallace Wright Adamson, M.B., Ch.B., 1, Ashwood Villas, Headingley Lane, Leeds.
Shanti Swarupa Bhatnagar, M.Sc., University College, Gower Street, W.C.1.
Walter Theodore Karl Braunholtz, B.A., Goslar, Adams Road, Cambridge.
Patrick Gill Griffith, Three Gables, Walton-on-Thames.
Jenkyn Arthur Griffiths, 60, Porchester Terrace, Bayswater, W. 2.
Harry Millar Jacobs, Umhlatuzi Mill, Filixton, Zululand.
Len David Jones, B.Sc., Box 1163, Johannesburg, S. Africa.
Jagadindranath Lahiri, M.Sc., Khirertolla, Howrah, India.
Phyllis Violet McKie, M.Sc., Castle Bank, Bangor.
Ida Smedley MacLean, D.Sc., 68, Overstrand Mansions, S.W. 11.

Don Joseph Nicholas Perera, B.Sc., 26, Great Prescott Street, E. 1.
Nora Renouf, 29, Stanley Gardens, W. 11.
Marion Crossland Soar, B.Sc., 50, Barnmead Road, Beckenham.
Ronald Sutcliffe, 11, Henderson Road, Sunderland.
Sylvester Solomon Zilva, D.Sc., Ph.D., Lister Institute, Chelsea Gardens, S.W. 1.

Messrs. G. Barr and C. S. Ellis were elected Scrutators, and a ballot for the election of Fellows was held. The following were subsequently declared elected as Fellows:

Urban Aspey.
Pramod Krisor Banerjee, M.Sc.
Henry Leonard Bolton.
David MacIntyre Boyd.
Philip Buckle, B.Sc.
Wattie Alan Burford.
Leonard Arthur Merritt Burt.
Lionel Sidney Cheeseright, M.C.
Cecil Henry Douglas Clark, B.Sc.
Frederick James Darbyshire, B.Sc.
Richard Harry Doughty.
William Henry Farrant.
John Charles Frodsham.
Alban Godwin Gordon, B.Sc.
William Herbert Gray, M.Sc.
Robert Gray Hails.
Alfred Douglas Heywood.
John Isaacs Hill, B.Sc.
Roderick Miller Douglas Hodge.
Harold Hunter, B.Sc.
John William Lamb.
Thomas Lambert.
Harry Lowery, B.Sc.
Norman Lynn.
James Mathews McEntegart, M.Sc.
Harry Bulmer Marston, B.Sc.
Arthur Douglas Miniman, M.A.
John Stanley Morgan, M.Sc.
William Burnett Reina Newlands.
Percival Frederick Novis.
Harold Osborn.
Thomas Clark Petrie.
Harold James Poole, B.Sc.
Akira Shimomura.
William Singleton.
Frederick Charles Smith.
William James Smith.
Robert John Sudlow.
Ronald Hawkesby Thomas.
Phuldeo Sahay Varma, M.Sc.
Roland Woods, M.B.E.

Prof. J. C. McLennan, F.R.S., then delivered his Lecture on "Helium." A vote of thanks to the Lecturer, proposed by Prof. Smithells, seconded by Prof. Donnan, supported by Sir Richard Threlfall, was carried with acclamation, and acknowledged by Prof. McLennan.

BYE-LAWS.

Copies of the new Bye-Laws of the Society, which came into force on June 1st, 1920, can now be obtained by Fellows on application to the Assistant Secretary.

LIST OF FELLOWS, 1920.

The List of Fellows for 1920 is being prepared, and changes of address received after July 31st, 1920, cannot be included therein. Fellows whose Christian names and degrees do not appear in full are particularly requested to notify the Assistant Secretary.

Owing to the increasing cost of paper and printing, the Council has decided that the List shall be sent to those Fellows only who make application.

THE LIBRARY.

The Library will be closed for Stocktaking from Monday, August 9th, until Saturday, August 21st, 1920, inclusive.

ADDITIONS TO THE LIBRARY.

I. *Donations*

INDIA, CHEMICAL SERVICES COMMITTEE, 1920. Report. Simla 1920. pp. xii + 122. (*Recd.* 20/5/20.) From the Committee.

CURTIS, A. H. Manganese ores. (Imperial Institute Monograph on Mineral Resources.) London 1919. pp. x + 118. 3*s*. 6*d*. net. (*Recd.* 25/5/20.) From the Director.

DAVIES, G. M. Tin ores. (Imperial Institute Monograph on Mineral Resources.) London 1919. pp. x + 112. 3*s*. 6*d*. net. (*Recd.* 25/5/20.) From the Director.

KENTISH, THOMAS. The pyrotechnist's treasury. The complete art of making fireworks. 2nd edition. London 1887. pp. xiv + 218. ill. (*Recd.* 7/5/20.) From Mr. Cecil Duncan.

MARTIN, GEOFFREY. Animal and vegetable oils, fats, and waxes . . ., including the manufacture of candles, margarine and butter. London 1920. pp. x + 218. ill. 12*s*. 6*d*. net. (*Recd.* 15/5/20.) From the Publishers: Messrs. Crosby Lockwood and Son.

MELDOLA, RAPHAEL. Chemistry. (Home University Library.) London [1913]. pp. 255. 2*s*. net. (*Recd.* 14/4/20.) From the Publishers: Messrs. Williams and Norgate.

MORTIMER, G. W. Pyrotechny; or, a familiar system of

recreative fire-works. 2nd edition. London [1824]. pp. xvi+126. ill. (*Recd.* 7/5/20.) From Mr. Cecil Duncan.

ONSLOW, MURIEL WHELDALE. Practical plant biochemistry. Cambridge 1920. pp. vi+178. 15*s.* net. (*Recd.* 15/5/20.) From the Publishers: The Cambridge University Press.

RASTALL, R. H., and WILCOCKSON, W. H. Tungsten ores. (Imperial Institute Monograph on Mineral Resources.) London 1920. pp. x+82. 3*s.* 6*d.* net. (*Recd.* 25/5/20.) From the Director.

SOCIETĂŢEI DE CHIMIE DIN ROMÂNIA. Buletinul. Year I, etc. Bucureşti 1919+. (*Reference.*) From the Society.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE. Journal. Vol. 27, etc. Glasgow 1919+. (*Reference.*) From the Faraday Society.

ZEITSCHRIFT FÜR ELEKTROCHEMIE und angewandte physikalische Chemie. Vol. 26, etc. Halle a. S. 1920+. (*For circulation.*) From the Faraday Society.

II. *By Purchase.*

BOUCHONNET, A. Bismuth, étain, plomb. Paris 1920. pp. x+376. 5*s.* net. (*Recd.* 21/5/20.)

BROWN, NELSON COURTLANDT. Forest products, their manufacture and use: embracing the principal commercial features in the production, manufacture, and utilization of the most important forest products other than lumber, in the United States. New York 1919. pp. xx+472. ill. 21*s.* net. (*Recd.* 12/5/20.)

CHALMERS, T. W. Paper making and its machinery: including chapters on the tub sizing of paper, the coating and finishing of art paper and the coating of photographic paper. London 1920. pp. xii+178. ill. 26*s.* net. (*Recd.* 13/5/20.)

CLASSEN, ALEXANDER, and CLOEREN, H. Quantitative analysis by electrolysis. Revised, rearranged and enlarged English edition. By WILLIAM T. HALL. New York 1919. pp. xiv+346. ill. 17*s.* 6*d.* net. (*Recd.* 12/5/20.)

DOLT, MAURICE L. Chemical French. An introduction to the study of French chemical literature. Easton, Pa., 1918. pp. viii+398. 18*s.* net. (*Recd.* 12/5/20.)

HISCOX, GARDNER D. [Editor]. Henley's twentieth century formulas, recipes and processes. Containing ten thousand selected household and workshop formulas. 1919 edition, revised and enlarged. New York 1919. pp. 807. (*Reference.*) 21*s.* net.

HURTER, FERDINAND, and DRIFFIELD, VERO CHARLES. See ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN.

Ingle, Herbert. A manual of agricultural chemistry. 4th edition. London 1920. pp. viii + 432. ill. 15*s*. net. (*Recd.* 12/5/20.)

Molinari, Ettore. Treatise on general and industrial inorganic chemistry. 2nd edition, translated from the 4th Italian edition by Thomas Henry Pope. London 1920. pp. xx + 876. ill. 42*s*. net. (*Recd.* 12/5/20.)

Monographieen aus der Geschichte der Chemie. Edited by Georg Wilhelm August Kahlbaum. I—VIII. Leipzig 1897—1904. ·ill. (*Recd.* 8/6/20.)

Noyes, William Albert. Organic chemistry for the laboratory. 3rd edition, revised and enlarged. Easton, Pa., 1916. pp. xii + 292. ill. 12*s*. net. (*Recd.* 12/5/20.)

Ostwald, Wilhelm, and Drucker, Carl. Handbuch der allgemeinen Chemie. III. Die Eigenschaften der Gase. Kinetische Theorie. Zustandsgleichung. By J. P. Kuenen. Leipzig 1919. pp. viii + 448. ill. (*Reference.*)

Phillips, Francis C. Chemical German. An introduction to the study of German chemical literature: including rules of nomenclature, exercises for practice and a collection of extracts from the writings of German chemists . . . and a vocabulary of German chemical terms and others used in technical literature. 2nd edition. Easton, Pa., 1915. pp. viii + 252. 12*s*. net. (*Recd.* 12/5/20.)

Planck, Max. Vorlesungen über die Theorie der Wärmestrahlung. 3rd edition. [Reprint of 2nd edition.] 1919. pp. x + 206. (*Recd.* 25/5/20.)

Rosenhain, Walter. Glass manufacture. 2nd edition. London 1919. pp. xvi + 258. ill. 12*s*. 6*d*. net. (*Recd.* 12/5/20.)

Royal Photographic Society of Great Britain. A memorial volume containing an account of the photographic researches of Ferdinand Hurter and Vero C. Driffield: being a reprint of their published papers, together with a history of their early work and a bibliography of later work on the same subject. Edited by William Bates Ferguson. London [1920]. pp. xii + 374. ill. 25*s*. net. (*Recd.* 17/5/20.)

Schwartz, — von. Fire and explosion risks . . . detection, investigation and prevention of dangers arising from fires and explosions of chemico-technical substances and establishments. Translated from the revised German edition by C. T. C. Salter. London [1904, reprinted 1918]. pp. xxii + 358. 18*s*. net. (*Recd.* 17/5/20.)

Seidell, Atherton. Solubilities of inorganic and organic sub-

stances. 2nd edition. London 1920. pp. xxii + 846. (*Reference.*) 45*s*. net.

SOCIETY OF CHEMICAL INDUSTRY. Reports of the progress of applied chemistry. Vol. II, 1917, etc. London 1918+. (*Reference.*)

STILLMAN, THOMAS BLISS. Engineering chemistry. A manual of quantitative chemical analysis for the use of students, chemists and engineers. 5th edition. Easton, Pa., 1916. pp. viii + 760. ill. 36*s*. net. (*Recd.* 12/5/20.)

TAYLOR, HUGH STOTT. Fuel production and utilization. London 1920. pp. xiv + 298. ill. 10*s*. 6*d*. net. (*Recd.* 12/5/20.)

VALLERY-RADOT, RENÉ. The life of Pasteur. Translated by MRS. R. L. DEVONSHIRE. With an introduction by SIR WILLIAM OSLER. London 1919. pp. xxii + 484. ill. 10*s*. 6*d*. net. (*Recd.* 17/5/20.)

WEST AFRICA. Committee on edible and oil-producing nuts and seeds. Report and minutes of evidence. 2 vols. London 1916. pp. 48, ii + 234. 2*s*. 4*d*. net. (*Recd.* 27/5/20.)

·WINKLER, CLEMENS. Lehrbuch der technischen Gasanalyse. 4th edition, edited by OTTO BRUNCK. Leipzig 1919. pp. xii + 254. ill. (*Recd.* 25/5/20.)

ZSIGMONDY, RICHARD. Kolloidchemie. 2nd edition. Leipzig 1918. pp. xvi + 402. ill. (*Recd.* 8/5/20.)

III. *Pamphlets.*

ALBUQUERQUE, MATHEUS D'ANDRADE. Oleatos e estearatos (sabões) de alguns metaes. (From the *Revista chim. pura applic.*, 1916, [ii], **1**.)

—— Sobre uma relação entre os espectros de absorpção visiveis de alguns metaes nos seus derivados: $M^{IV}X'_4$ e $(M_2)^{VI}X'_6$ (saes de sesquioxydo). (From the *Revista chim. pura applic.*, 1916, [ii], **1**.)

—— Catálise. (From the *Revista chim. pura applic.*, 1918, [ii], **3**.)

—— A variação dos calores atomicos em funcção da temperatura. Ponta Delgada 1919. pp. 20.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS. The chemical industries of German Rhineland: a summary of the report of the British Chemical Mission on chemical factories in the occupied area of Germany. London 1920. pp. 29. ill.

CHWOLSON, O. D. Sur les poids atomiques. (From the *Bull. Acad. Sci. Petrograd*, **1915**.)

FERGUSON, JOHN B. The term "inversion." (From *Science*, 1919, [N.S.], **50**.)

HUGHES, JOHN. The action of lime in the soil. (From the *J. Bath & W. & S. Co. Soc.*, 1919, [v], **13**.)

IMPERIAL MINERAL RESOURCES BUREAU. First annual report, with appendix. London 1920. pp. 24.

MERWIN, HERBERT EUGENE, and HOSTETTER, J. CLYDE. Hematite and rutile formed by the action of chlorine at high temperatures. (From the *Amer. Min.*, 1919, **4**.)

SEN, NAGENDRA NATH. Interaction of phosphorus halides and arsenious and arsenic compounds. (From the *J. Proc. Asiatic Soc. Bengal*, 1919, N.S. **15**.)

SINNATT, FRANK STURDY. Notes on coal analysis. (*Lancs. & Cheshire Coal Research Assoc.*, Bulletin No. 4.) 1920.

SINNATT, FRANK STURDY, STERN, HARRY, and BAYLEY, FRANK. Coal dust and fusain. (*Lancs. & Cheshire Coal Research Assoc.*, Bulletin No. 5.) 1920. pp. 20.

WEST, CLARENCE JAY. Chemical warfare. [Bibliography.] (From *Special Libraries*, 1919.)

—— A short bibliography of sulfite alcohol: a list of articles on the production of alcohol from sulfite waste liquor. (From *Paper*, 1919, **25**.)

—— The electric furnace as applied to metallurgy: a reading list, 1900—1919. (From *Trans. Amer. Electrochem. Soc.*, 1920, **37**.)

WEST, CLARENCE JAY, and GREENMAN, EDWARD D. A reading list on industrial research. With an introduction by ARTHUR D. LITTLE. (From *Special Libraries*, 1920.)

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, June 2nd, 1921, at 8 p. m., Dr. M. O. FORSTER, F.R.S., Treasurer, in the Chair.

The Chairman referred to the loss sustained by the Society, through death, of :

	Elected.	Died.
Thomas Hartley	Feb. 19th, 1920.	May 21st, 1921.

The following were formally admitted Fellows of the Chemical Society :

Sir F. Nathan, L. G. Hulls, and M. M. Mehta.

Certificates were read for the first time in favour of :

Adam Archibald Anthony, 15, West Parade, Rhyl.
Abu Mohamed Bakr, B.Sc., 121, St. Michael's Hill, Bristol.
Frederick Maynard Bland, 137, Parkdale Road, Plumstead, S.E. 18.
William George Brabyn, 7, Livingston Road, Battersea, S.W. 11.
Parvataneny Siviah Chowdary, 11, Union Street, Aberdeen.
George Ernest Collins, B.Sc.Tech., 37, Marshall Road, Levenshulme, Manchester.
Iresh Chandra Gupta, M.Sc., 21, Cromwell Road, S.W. 7.
Stanley Reginald Hole, 10, Ringstead Road, Catford, S.E. 6.
Ernest Albert Rudge, B.Sc., A.I.C., 21, Syr David's Avenue, Cardiff.
Leonard Sachs, 280, Market Street, Pretoria, S. Africa.
Thomas Marvel Sharp, B.Sc.Tech., A.I.C., 62, Longley Road, Harrow-on-the-Hill.

The following papers were read :

"Derivatives of sulphur in commercial salvarsan. Part I." By H. KING.

"Physical chemistry of the oxides of lead. Part I. The solubility of lead monoxide." By S. GLASSTONE.

"Latent heats of fusion. Part I. Benzophenone, phenol, and sulphur." By K. STRATTON and J. R. PARTINGTON.

"Researches on residual affinity and co-ordination. Part V. Gallium acetylacetone and its analogues." By G. T. MORGAN and H. D. K. DREW.

"Interaction of sulphur monochloride with organic acid amides." By K. G. NAIK.

"Some new tricyclic bases." By T. S. MOORE and I. DOUBLEDAY.

"Experiments on the synthesis of the polyacetic acids of methane. Part II. Some abnormal condensations of malonic and cyanoacetic esters with halogenated methanes." By C. K. INGOLD and W. J. POWELL.

Ordinary Scientific Meeting, held in the Lecture Hall of the Institution of Mechanical Engineers on Thursday, June 16th, 1921, at 8 p.m., Sir JAMES WALKER, D.Sc., F.R.S., President, in the Chair.

The PRESIDENT announced the loss sustained by the Society, through death, of the following Fellows:

	Elected.	Died.
John Hughes	Dec. 17th, 1868	June 5th.
Alexander Mitchell Kellas	May 3rd, 1894	June 5th.

Certificates were read for the first time in favour of:

Cyril Wilfred Bonniksen, B.Sc., c/o Messrs. Lockett Bros., Ltd., Casilla 714, Iquique, Chile.
Edmund John Bowen, B.A., University College, Oxford.
Arthur Benjamin Bradley, 7A, Inglethorpe Street, Fulham, S.W. 6.
James Bridge, Gas Works, Elland, Yorks.
Oliver Anthony Patrick Clark, 5, Grove Lane, Kingston-on-Thames.
John William Fuller, 35, Chesholm Road, Stoke Newington, N. 16.
Harold Reginald Humphreys, 61, Somers Road, Walthamstow, E. 17.
Paul Nicolai Koggerman, The University, Dorpat, Esthonia.
Hubert William Henry Lee, 24, Onslow Gardens, Wallington, Surrey.
Charles Wentworth Levy, 76, Wellingboro' Road, Rushden, Northants.
Iven Ludvig Alexander Odèn, The University, Stockholm.
George James Warren, 28, Bavent Road, Camberwell, S.E. 5.

Certificates have been authorised by the Council for presentation to Ballot under Bye-law I (2) in favour of:

Henry Oscar Askew, M.A., Rosthwaite, Konini Road, Riccarton, Christchurch, New Zealand.
Lawrence Wade Bass, Ph.B., 1248, Yale Station, New Haven, Connecticut, U.S.A.
Ernest Edward Hartmann, 222, Hamilton Street, Bound Brook, N.J., U.S.A.

Messrs. J. G. F. Druce and H. S. Redgrove were elected Scrutators, and a ballot for the election of Fellows was held. The following were subsequently declared elected as Fellows:

Sydney Bowie, B.Sc.
George Bernard Brook, F.I.C.
Johannes Sybrandt Buck, B.Sc., A.I.C.
Alan Newton Campbell, B.Sc.
Alfred Herbert Dodd, B.A., A.I.C.
Clarence Victor Ferriss, B.Sc.
Adolph L. Friedenthal, B.A.
Nand Lall Gheik, B.Sc.
Cecil Sayers Harman.
John Alfred Hindle.
Louis Hunter, B.Sc.
Evelyn Arthur Mason, B.Sc.
John Charles Mellersh.
John Mendus.
Satya Prosonna Mukerjee.
Sheikh Muzaffar-ud-Din, M.Sc.
George Norman Myers.
Joseph Poulson.
Ronald Arthur Pratt.
James Walter Edward Ross.
Sailendra Nath Sen, B.Sc.
Antonin Šimek, Ph.D.
Frank Bergmann Small.
George Spall.
John Frederick Smerdon Stone.
Claude Moorhouse Stoney.
Muneo Tani.
George Frederick William Webb.
William Meirion Williams.
Roland de Zoysa, B.Sc.

Professor Benjamin Moore, F.R.S., then delivered his Lecture on "The Natural Photo-synthetic Processes on Land and in Sea and Air, and their relation to the Origin and Preservation of Life Upon the Earth." A vote of thanks to the Lecturer, proposed by Dr. H. H. Dale, seconded by Prof. G. T. Morgan, and supported by the Chairman, was carried with acclamation, and acknowledged by Professor Moore.

LIST OF FELLOWS, 1921.

The List of Fellows for 1921 is being prepared, and changes of address received after July 31st, 1921, cannot be included therein. Fellows whose Christian names and degrees do not appear in full are particularly requested to notify the Assistant Secretary.

Owing to the heavy cost of printing, the List will only be sent to those Fellows who make application.

THE LIBRARY.

The Library will be closed for Stocktaking from Monday, August 1st, until Saturday, August 13th, 1921, inclusive.

During the four weeks, August 15th to September 10th, the Library will close daily at 5 p.m.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

ATACK, FREDERICK WILLIAM [Editor], assisted by LEONARD WHINYATES. The Chemists' Year Book 1921. Manchester 1921. pp. viii+1142. ill. (*Reference.*) 21*s.* From the Author.

COPAUX, H. Introduction to general chemistry: an exposition of the principles of modern chemistry. Translated by HENRY LEFFMANN. Philadelphia [1920]. pp. x+196. ill. $2.00 net. (*Recd.* 10/5/21.)
From the Publishers: Messrs. P. Blakiston's Son & Co.

CROSS, CHARLES FREDERICK, and BEVAN, EDWARD JOHN. A text-book of paper-making. Containing additional matter . . . with collaboration of JOHN FREDERICK BRIGGS. 5th edition. London 1920. pp. xii+528. ill. 30*s.* net. (*Recd.* 27/5/21.)
From the Authors.

HAUSDING, A. Handbuch der Torfgewinnung und Torfverwertung. 4th edition. Berlin 1919. pp. xvi+534. ill. (*Recd.* 26/5/21.) From Mr. H. M. Spiers.

KNAPP, ARTHUR WILLIAM. Cocoa and chocolate: their history from plantation to consumer. London 1920. pp. xii+210. ill. 12*s.* 6*d.* net. (*Recd.* 12/5/21.) From the Author.

MARTIN, GEOFFREY. Perfumes, essential oils, and fruit essences used for soap and other toilet articles . . . including their chief constants, methods of analysis, and numerous practical recipes, for the chief perfuming mixtures. London 1921. pp. viii+138. ill. 12*s.* 6*d.* net. (*Recd.* 6/6/21.)
From the Publishers: Messrs. Crosby Lockwood & Co.

MOUREU, CHARLES. La chimie et la guerre: science et avenir. Paris 1920. pp. vi+384. 10 *fr.* net. (*Recd.* 26/5/21.)
From the Publishers: MM. Masson et Cie.

NEWLANDS, JOHN ALEXANDER REINA. On the discovery of the periodic law, and on relations among the atomic weights. London 1884. pp. viii+40. (Second copy.) From Mr. J. C. N. Eastick.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB. Transactions. N.S. Nos. 19—30, and 33. Oxford 1904—1907, 1909. (*Reference.*)
From Mr. R. N. Garrod Thomas.

PARTINGTON, JAMES RIDDICK. A text-book of inorganic chemistry for university students. London 1921. pp. xiv+1062. ill. 25*s.* net. (*Recd.* 13/5/21.) From the Author.

PHILIP, JAMES CHARLES. The romance of modern chemistry: a description in non-technical language of the diverse and wonderful ways in which chemical forces are at work, and of their manifold

application in modern life. London 1920. pp. 348. ill. 6*s*. net. (*Recd.* 13/6/21.) From the Author.

PLIMMER, ROBERT HENRY ADERS. Analyses and energy values of foods. London 1921. pp. 256. 6*s*. net. (*Recd.* 13/6/21.) From the War Office.

SMITH, EDGAR FAHS. Priestley in America. 1794—1804. Philadelphia [1920]. pp. [vi]+174. $1.50 net. (*Recd.* 10/5/21.) From the Publishers: Messrs. P. Blakiston's Son & Co.

SPENCER, JAMES FREDERICK. An experimental course of physical chemistry. I. Statical experiments. 2nd edition. London 1921. pp. xvi+248. ill. 6*s*. net. (*Recd.* 9/6/21.) From the Author.

WELLS, A. E., and FOGG, D. E. The manufacture of sulphuric acid in the United States. (*U.S. Bureau of Mines*, Bulletin 184.) Washington 1920. pp. viii+216. ill. (*Recd.* 31/5/21.) From Mr. R. N. Garrod Thomas.

II. *By Purchase.*

BREARLEY, HARRY. The case-hardening of steel: an illustrated exposition of the changes in structure and properties induced in steels by cementation and allied processes. 2nd edition. London 1921. pp. xii+208. ill. 16*s*. net. (*Recd.* 14/6/21.)

CATHCART, EDWARD PROVAN. The physiology of protein metabolism. New edition. London 1921. pp. viii+176. 12*s*. 6*d*. net. (*Recd.* 12/5/21.)

COUCH, JAMES F. A dictionary of chemical terms. New York 1920. pp. iv+204. (*Reference.*) 18*s*. 6*d*. net.

CUNNINGHAM, E. Relativity, the electron theory, and gravitation. 2nd edition. London 1921. pp. viii+148. ill. 10*s*. 6*d*. net. (*Recd.* 14/6/21.)

FRIEND, JOHN NEWTON [Editor]. A text-book of inorganic chemistry. Vol. IX. Part ii. Iron and its compounds. By JOHN NEWTON FRIEND. London 1921. pp. xxvi+266. (*Reference.*) 18*s*. net.

HARROW, BENJAMIN. Vitamines: essential food factors. New York [1921.] pp. xiv+220. ill. 16*s*. net. (*Recd.* 31/5/21.)

HART, EDWARD. A text-book of chemical engineering. Easton, Pa. 1920. pp. xii+212. ill. 24*s*. net. (*Recd.* 18/5/21.)

HOYT, SAMUEL L. Metallography. Part II. New York 1921. pp. x+462. ill. 28*s*. net. (*Recd.* 13/6/21.)

KISSLING, RICHARD. Handbuch der Tabakkunde, des Tabakbaues und der Tabakfabrikation. 4th edition. Berlin 1920. pp. xii+470. ill. (*Recd.* 31/5/21.)

MEYER, STEFAN, and SCHWEIDLER, EGON RITTER VON. Radioaktivität. Leipzig 1916. pp. xii+542. ill. (*Recd.* 20/5/21.)

RAMANN, EMIL. Bodenkunde. 3rd edition. Berlin 1911, reprinted 1920. pp. xvi+620. ill. (*Recd.* 31/5/21.)

ROYDS, R. Heat transmission in boilers, condensers, and evaporators. London 1921. pp. viii+302. ill. 24*s.* net. (*Recd.* 14/6/21.)

——. The measurement of steady and fluctuating temperatures. London 1921. pp. xii+162. ill. 16*s.* net. (*Recd.* 14/6/21.)

SCHWALBE, GUSTAV CARL [Editor]. Die chemische Untersuchung pflanzlicher Rohstoffe und der daraus abgeschiedenen Zellstoffe: Sammlung kritischer Referate über Faserstoff-Analysenmethoden. Berlin 1920. pp. xxiv+159. (*Recd.* 24/5/21.)

SVEDBERG, THE. The formation of colloids. London 1921. pp. 127. ill. 7*s.* 6*d.* net. (*Recd.* 14/6/21.)

WITTHAUS, R. A. Manual of toxicology. 2nd edition. New York 1911. pp. x+1262. ill. 42*s.* net. (*Recd.* 26/5/21.)

III. *Pamphlets.*

AUSTRALIA, COMMONWEALTH OF, *Institute of Science and Industry.* Bulletin No. 19. Wood waste. By I. H. BOAS. Melbourne 1921. pp. 82. ill.

—— ——. Bulletin No. 20. Power-alcohol: proposals for its production and utilization in Australia. With addendum by GERALD LIGHTFOOT. Melbourne 1921. pp. 104. ill.

BARROWS, FRANK E. Investigations of the chemical literature. (From *Chem. and Met. Eng.*, 1921, **24**.)

MERWIN, HERBERT EUGENE. Chemical researches on sediments. (From the *Bull. Geol. Soc. America,* 1920, **31**.)

NUCKOLLS, A. H. Corrosive action and nature of products formed when carbon tetrachloride extinguisher liquids are applied to fires. (From the *National Fire Protection Assoc. Quart.*, 1921.) ill.

RICARDO, H. R. The influence of various fuels on the performance of internal combustion engines: an experimental investigation into their behaviour. (From the *Automobile Engineer,* 1921.)

SCIENTIFIC AND INDUSTRIAL RESEARCH, Department of. *Food Investigation Board.* Special Report No. 6. The "black spot" of chilled and frozen meat. By F. T. BROOKS and M. N. KIDD. London 1921. pp. ii+6. ill.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, October 6th, 1921, at 8 p.m., Dr. M. O. FORSTER, F.R.S., Treasurer, in the Chair.

Reference was made to the loss sustained by the Society, through death, of the following Fellows:

	Elected.	Died.
David Brown	Mar. 17th, 1870	June 21st.
Francis William Buckland Cunnington	Feb. 15th, 1917	July, 1920
Charles Estcourt	Feb. 2nd, 1865	June 24th
Tribhuvandas Kalyandas Gajjar	Dec. 5th, 1901	——
Henry Tresawna Gerrans	Feb. 21st, 1895	June 20th
Edward Gunersall	Dec. 4th, 1902	May 18th
Harold Edward Pollock Hodsoll	May 15th, 1913	Sept. 2nd
Ernest James Hoy	Dec. 2nd, 1915	July 5th
Henry Rondel Le Sueur..................	Feb. 21st, 1895	July 9th
Frederic Richard Mallet.................	May 7th, 1885	June 24th
Henry Stephen Martin	Feb. 20th, 1913	Mar. 16th
John William Reginald Youll	Dec. 5th, 1918	July 6th

Certificates were read for the first time in favour of:

Harry Anderson, B.A., 9, Mill Street, Oakham.
Francis Bartlett Arnold, 23, Stratford Road, Thornton Heath.
Hugh Chester Bell, M.A., Guy's Hospital Medical School, S.E. 1.
Frederick John Berry, 51, Reynolds Street, Neutral Bay, Sydney, N.S.W.
Jagadish Chandra Bhowmik, M.Sc., 72, Harrison Road, Calcutta.
Joseph Roy Booer, B.Sc., 7, Gabriel Street, Honor Oak Park, S.E. 23.
Frederick George Braithwaite, Messrs. Lever Bros. (S.A.), Ltd., Durban.
William Arthur Percival Challenor, M.Sc., Glenwood, Alkington Road, Whitchurch.
Philibert Camille Chaumeton, B.Sc., A.I.C., Messrs. Duroglass, Ltd., 92, Fore Street, E.C. 2.
George Henry Croft, M.Sc., 13, Lowther Street, York.
David Richard Dawkins, B.Sc., Llwyncelyn, Wern Road, Skewen, Neath.
Cecil Whitfield Davies, B.Sc., A.I.C., 135, Copers Cope Road, Beckenham.
Geoffrey Fairrie, Rosslyn, Merrilocks Road, Blundellsands, Liverpool.

Robert Allen Fitzsimons, B.Sc., 43. King Henry's Road, Hampstead, N.W. 3.
Percy James Fullerton, 107, Macoma Road, Plumstead, S.E. 18.
William Buchanan Gray, Box 663, Johannesburg.
Solomon Greenberg, A.I.C., 41, Frithville Gardens, W. 12.
Leslie Hall, B.Sc., 87, College Road, Isleworth.
Percy Charles Haywood, M.Sc., 3, Gladstone Road, Wimbledon, S.W. 19.
Harold Robert Hellyer, 140, Elizabeth Street, Sydney.
Gwendolen Hindes, B.Sc., Wesley Manse, Barlow Street, Oldham.
Cyril Norman Hinshelwood, B.A., Balliol College, Oxford.
George Ingham, B.A., A.I.C., Messrs. Kynochs, Ltd., Umbogintwini, Natal.
Kenneth James Isaac, 42, Nicoll Road, Harlesden, N.W. 10.
Geraldine Zarika Lee Le Bas, B.Sc., Imperial Club, Dover Street, W. 1.
Alexander Bernard Manning, M.Sc., 102, Fordhook Avenue, Ealing Common, W. 5.
John Henry Middleditch, 15, Fonthill Road, Hove, Brighton.
James Gibb Mitchell, B.Sc., Laurelbank, Cupar.
George Norman Nicklin, M.A., 9, Willis Road, Cambridge.
John Griffith Peake, Erskine, Prospect Road, Summer Hill, Sydney.
John Robert Pickering, 113, Mayola Road, Lower Clapton, N.E. 5.
Norman Ratcliffe, F.I.C., Messrs. The Glaxo Manufacturing Co., Hamilton, N.Z.
Thomas Harold Reade, B.A., M.Sc., A.I.C., 118, Tettenhall Road, Wolverhampton.
William Reverson, Philomel, Pelham Road, Bexley Heath.
Hugh Medwyn Roberts, B.Sc., A.I.C., Hendy, Crescent Road, Rhyl.
Kasinath Saikia, B.A., Elvestone, Shillong, Assam.
Horace Leonard Saunders, B.Sc., A.I.C., 177, Chepstow Road, Newport, Mon.
Schachno Peisach Schotz, D.Sc.Tech., B.Sc., F.I.C., 112, Wellington Road South, Hounslow.
William George Shilling, The Mill, Preston Village, Faversham.
Walter William Sirman, B.Sc., 222, Reddings Lane, Hall Green, Birmingham.
George Paterson Storer, A.I.C., 48, Llanthewy Road, Newport, Mon.
Enoch Swan, B.Sc., 129, Liverpool Road, Birkdale, Southport.
Walter Thomas, 24, Richborough Road, Cricklewood, N.W. 2.
Stanley Horwood Tucker, Lincoln College, Oxford.
Edith Hilda Usherwood, B.Sc., 10, Holly Park Gardens, Finchley, N. 3.
William Mansergh Varley, M.A., D.Sc., Ph.D., 7, Preston Park Avenue, Brighton.
Panna Lal Verma, B.Sc., University College, Dundee.
Bertram Thomas Watson, 36, Coopersale Road, Homerton, E. 9.
James Henry Wilkinson, 18, Stockton Road, Sunderland.
Bernard Howell Wilsdon, M.A., B.Sc., Lyallpur, Punjab.
Percival Harry Woodnoth, 88, Rodenhurst Road, Clapham Park, S.W. 4.

The following papers were read :

"A new adjustable thermostat for all temperatures between 0° and 100°." By S. J. Lewis and F. M. Wood.

"The separation of miscible liquids by distillation. Laboratory still-heads." By A. F. Dufton.

"The separation of miscible liquids by distillation. A continuous laboratory still." By A. F. Dufton.

"The action of diazo-salts on aromatic sulphonamides. Part I." By P. K. Dutt, H. R. Whitehead, and A. Wormall.

"Neutral salt action on the hydrolysis of ethyl formate." By A. B. Manning.

"Synthetic optical activity." By A. Shimomura and J. B. Cohen.

"The mechanism of the action of fused alkalis. Part II. Action of fused potassium hydroxide on phenylglyceric acid." By (the late) H. R. Le Sueur and C. C. Wood.

Ordinary Scientific Meeting, Thursday, October 20th, 1921, at 8 p.m., Sir James Walker, D.Sc., LL.D., F.R.S., President, in the Chair.

The President referred to the loss sustained by the Society, through death, of:

	Elected.	Died.
Edward John Bevan	Mar. 1st, 1883	Oct. 17th
Sir Edward Chaning Wills	May 7th, 1896	Oct. 14th

The President announced:

(1) That the Council had appointed Dr. J. Irvine Masson to fill the vacancy in the office of Secretary caused by the death of Dr. H. R. Le Sueur.

(2) That up to the present the sum of £106 18*s*. 6*d*. had been received for the Russian Fund, and various gifts of clothing. The first consignment of clothing and a small sum will shortly be sent to the Secretary of the Helsingfors University Committee for distribution amongst Russian scientific men.

Certificates were read for the first time in favour of:

George Norman Burkhardt, B.Sc., Hulme Hall, Victoria Park, Manchester.
Harold Eben Carr, Lynton, St. Augustine's Avenue, S. Croydon.
John Stanley Carter, Holly Farm, Farnley, Leeds.
Maurice Hepburn Cocks, The Holme, Ashtead, Epsom.
Frank Dickens, B.A., 37, Cale Street, Chelsea, S.W. 3.
Nazim Fakhoury, The University, Edgbaston, Birmingham.
Gilbert Greenwood, B.Sc., Thorn Bank, Edenfield, Manchester.
George Herbert Griffiths, 23, Drummond Road, Hoylake, Birkenhead.
Harold Joseph Hailstone, The Gas Works, Rochdale.
Ernest Sydney Hedges, B.Sc., Blenheim, Albert Avenue, Sedgley Park, Prestwich, Manchester.
Wilfred Alec Hodsdon, Springfields, Bexley, Kent.
Archibald Montgomery Low, 1 Woodstock Road, Bedford Park, W. 4.
James Nicol, 12, Vectis Road, Tooting, S.W. 17.
David Arthur Ruell, B.Sc., 17, Thornton Street, West Hartlepool.
Fred Wooler Simpson, Cheapside, Spennymoor, Co. Durham.
Lennart Smith, University College, Gower Street, W.C. 1.
Bernard Wyndham Whitfeild, A.I.C., Gordon College, Khartoum.
James George Wilkie, 11, Luxemburg Gardens, Hammersmith, W. 6.

The following papers were read:

"Nitro- and amino-derivatives of 4-phenylglyoxaline." By R. L. Grant and F. L. Pyman.

"Chenopodium oil." By T. A. Henry and H. Paget.

"Some further experiments in a new method for the determination of molecular weights." By P. Blackman.

"The reversibility of the Michael reaction." By C. K. Ingold and W. J. Powell.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December next. Applications for Grants, to be made on forms obtainable from the Assistant Secretary, The Chemical Society, Burlington House, W. 1., must be received on or before Thursday, December 1st, 1921.

All persons who received Grants in December, 1920, or in December of any previous year, whose accounts have not been closed by the Council, are reminded that reports must be returned by December 1st.

ADDITIONS TO THE LIBRARY.

I. *Presented by Sir J. J. Dobbie.*

(*a*) Ten pamphlets and reprints of papers by Professor John Ferguson, including the following not already contained in the Library.

Ferguson, John. Bibliographical notes on the English translation of Polydore Vergil's work "De inventoribus rerum." (From *The Archaeologia*, 1888, **51**.)

—— Bibliographical notes on histories of inventions and books of secrets. Parts IV—VI. (From the *Trans. Archaeol. Soc. Glasgow*, 1888—1890.)

—— Bibliographical note on the "De triumpho stultitiæ" of Perisaulus Faustinus. (From *The Library*, 1890.)

—— Bibliographia Paracelsica. Contributions towards a knowledge of Paracelsus and his writings. Part III. Glasgow 1890. pp. 66.

(*b*) Fifty-three pamphlets and reprints of papers by Sir William Ramsay, including the following not already contained in the Library.

Ramsay, Sir William. Investigations on the toluic, and nitrotoluic acids. Inaugural dissertation for the attainment of the degree of Doctor of Natural Sciences. Tübingen 1872. pp. 27.

RAMSAY, SIR WILLIAM. On smell. [London 1882.] pp. 14.
—— Universities abroad. (From the *Times*, June 8—9, 1892.)
—— University extension lectures. Syllabus of a course of twenty-five lectures on the history of chemical discovery. London 1895. pp. 15.
—— Education in science in Britain and in Germany. Address delivered . . . at the opening ceremony of the session 1896—97, September 30th, 1896, University College of North Wales, Bangor. Bangor 1896. pp. 19.
—— The inert constituents of the atmosphere. (From the *Popular Sci. Monthly*, 1901.)
—— Einige Betrachtungen über das periodische Gesetz der Elemente. (From the *Verh. Ges. deut. Naturforsch. Ärzte*, 1903.)

II. *Miscellaneous Donations.*

AUDEN, HAROLD ALLDEN. Sulphur and sulphur derivatives. London [1921]. pp. xviii + 101. ill. 3*s*. net. (*Recd.* 9/9/21.)
From the Publishers: Sir Isaac Pitman & Sons.

BARNETT, EDWARD DE BARRY, and THORNE, PERCY CYRIL LESLEY. Organic analysis: qualitative and quantitative. London 1921. pp. xii + 168. ill. 7*s*. 6*d*. net. (*Recd.* 4/10/21.)
From the Publishers: The University of London Press.

BHAGWAT, VINAYAK KESHAV. Calculations in organic chemistry. Bombay 1921. pp. xii + 138. (*Recd.* 15/8/21.)
From the Author.

BRITISH OPTICAL INSTRUMENT MANUFACTURERS' ASSOCIATION. Dictionary of British scientific instruments. London 1921. pp. xii + 334. ill. (*Reference.*) 21*s*. net. From the Association.

BUREAU OF BIO-TECHNOLOGY. Bulletin. No. 1 etc., Leeds 1920+. ill. (*Reference.*) From the Bureau.

CRONSHAW, HARRY BRENAN. Silver ores. (Imperial Institute Monograph on Mineral Resources.) London 1921. pp. 152.
From the Director.

CURIOSITIES IN CHYMISTRY: being new experiments and observations concerning the principles of natural bodies. Written by a Person of Honour, and published by his operator, H. G. London 1691. pp. [vi] + 113. (*Reference.*) From Dr. A. Scott.

EGYPT. *Department of Public Health.* Reports and notes of the Public Health Laboratories, Cairo. No. 4. Nutritive values and characters of rations issued to officials . . . of the Egyptian Government. Cairo 1921. pp. vi + 57. *P. T.* 20. (*Recd.* 19/7/21.)
From the Department.

Farmer, Robert Crosbie. Industrial and power alcohol: the sources, production, and denaturing of alcohol—its manifold chemical and physical applications in industries and manufactures, and its use as a fuel for internal combustion engines—technical, commercial, and excise aspects of the problem. London 1921. pp. x + 110. ill. 2*s.* 6*d.* net. (*Recd.* 19/8/21.)
From the Publishers: Sir Isaac Pitman & Sons.

Fierz-David, Hans Eduard. Reise durch einige Industriegebiete der Vereinigten Staaten von Nord-Amerika, September—November 1920. Zürich 1921. pp. 79. ill. (*Recd.* 7/10/21.)
From the Author.

Geneeskundig Laboratorium te Weltevreden. Mededeelingen. 3rd Series A. 1917—18 etc., Weltevreden 1918+. (*Reference.*) ill. From the Director.

Gowland, William. The metallurgy of the non-ferrous metals. 3rd edition. London 1921. pp. xxxii + 632. ill. 30*s.* net. (*Recd.* 30/9/21.) From the Author.

Imperial Institute. Indian Trade Enquiry. Reports on jute and silk. London 1921. pp. x + 90. 5*s.* net. (*Recd.* 4/10/21.)
From the Director.

—— —— Reports on timbers and paper materials. London 1921. pp. x + 57. 4*s.* net. (*Recd.* 15/8/21.) From the Director.

Kay, Sydney Alexander. A text-book of qualitative analysis of inorganic substances. London 1921. pp. viii + 80. ill. 7*s.* 6*d.* net. (*Recd.* 4/10/21.) From the Publishers: Messrs. Gurney & Jackson.

Lampadius, Wilhelm August. Handbuch der chemischen Analyse der Mineralkörper. Freyberg 1801. pp. viii + 364. ill. (*Reference.*) From Professor P. Phillips Bedson.

—— Beyträge zur Erweiterung der Chemie und deren Anwendung auf Hüttenwesen, Fabriken und Ackerbau. Vol. I. Freyburg 1804. pp. viii + 342. ill. (*Reference.*) From Professor P. Phillips Bedson.

Moureu, Charles. Fundamental principles of organic chemistry. Translated from the 6th French edition by Walter T. K. Braunholtz. London 1921. pp. xviii + 400. 12*s.* 6*d.* net. (*Recd.* 15/8/21.) From the Publishers: Messrs. G. Bell & Sons.

Odling, William. Chemistry. London [1883]. pp. vi + 126. (*Recd.* 7/9/21.) From Mrs. Mary B. Odling.

Parkinson, James. The chemical pocket-book, or memoranda chemica; arranged in a compendium of chemistry, according to the latest discoveries, with Bergman's table of single elective attractions, as improved by Dr. G. Pearson. Calculated, as well for the occasional reference of the professional student, as to supply others with a general knowledge of chemistry. London 1800. pp. xii + 1—169, *152—*169, 170, 169—216. (*Reference.*)
From Professor P. Phillips Bedson.

* PATTERSON, AUSTIN M. A French-English dictionary for chemists. New York 1921. pp. xviii + 384. (*Reference.*) 18*s.* net. From the Publishers : Messrs. Chapman & Hall.

PAVENTA, E. F. Italian technical words and phrases : an English-Italian and Italian-English dictionary of technical and business terms and phrases. London 1921. pp. 308. (*Reference.*) 6*s.* net. From the Publishers : Messrs. E. Marlborough & Co.

PFEFFER, W. Osmotische Untersuchungen : Studien zur Zellmechanik. 2nd edition. Leipzig 1921. pp. xiv + 236. ill. (*Recd.* 26/9/21.) From the Publisher : Wilhelm Engelmann.

REVUE CHIMIQUE. Časopis za čistu kemiju i za sve grane primenjene kemije. Vol. I, etc. Zagreb 1921 +. (*Reference.*)

RICHARDSON, WILLIAM. The chemical principles of the metallic arts. Birmingham 1790. pp. civ + 205. (*Reference.*) From Professor P. Phillips Bedson.

ROAF, HERBERT ELDON. Biological chemistry. London [1921]. pp. xvi + 216. ill. 10*s.* 6*d.* net. (*Recd.* 28/9/21.) From the Author.

SEXTON, ALEXANDER HUMBOLDT. Fuel and refractory materials. New edition. By WILLIAM BROWN DAVIDSON. London 1921. pp. [x] + 382. ill. 12*s.* 6*d.* net. (*Recd.* 4/10/21.) From the Publishers : Messrs. Blackie & Son.

UNITED STATES DEPARTMENT OF COMMERCE. *Bureau of the Census.* Abstract of the census of manufactures, 1914. Washington 1917. pp. 722. (*Reference.*) From Mr. R. N. Garrod Thomas.

WEYL, THEODOR [Editor]. Die Methoden der organischen Chemie. 2nd edition. Edited by JOSEF HOUBEN. Vol. I. Leipzig 1921. pp. xxvii + 1121. ill. (*Recd.* 11/7/21.) From the Publisher : Georg Thieme.

WHITMORE, FRANK C. Organic compounds of mercury. New York 1921. pp. 398. $4·50. (*Recd.* 15/8/21.) From the Publishers : Chemical Catalog Company.

III. *By Purchase.*

BERTHOLLET, CLAUDE LOUIS, and BERTHOLLET, AMÉDÉE B. Elements of the art of dyeing and bleaching. New edition. Translated by ANDREW URE. London 1841. pp. xvi + 540. ill. (*Reference.*)

BOLAS, BERNARD D. A handbook of laboratory glass-blowing. London 1921. pp. viii + 106. ill. 3*s.* 6*d.* net. (*Recd.* 18/6/21.)

BURGESS, CHARLES F., PULSIFER, H. B., and FREUD, BENJAMIN B. Applied electrochemistry and metallurgy : a practical treatise on commercial chemistry, the electric furnace, the manufacture of

ozone and nitrogen by high-tension discharges, and the metallurgy of iron, steel, and miscellaneous metals. Chicago 1920. pp. viii + 198. ill. 17*s*. net. (*Recd.* 15/8/21.)

Coffignier, Ch. Les vernis. Paris 1921. pp. viii + 640. ill. 40*fr*. (*Recd.* 15/6/21.)

Comey, Arthur Messinger, and Hahn, Dorothy A. A dictionary of chemical solubilities—inorganic. 2nd edition. New York 1921. pp. xx + 1142. 72*s*. net. (*Reference.*)

Deutscher Färber-Kalender. Wittenberg 1921. pp. 221. ill. (*Reference.*)

Fritsch, J. Les huiles industrielles et leurs dérivés. Paris 1920. pp. viii + 357. ill. 17*s*. 6*d*. (*Recd.* 22/6/21.)

Hausbrand, E. Die Wirkungsweise der Rektifizier- und Destillier-Apparate mit Hilfe einfacher mathematischer Betrachtungen. 4th edition. Berlin 1921. pp. x + 270. ill. (*Recd.* 15/7/21.)

Lehmann, Otto. Die neue Welt der flüssigen Kristalle und deren Bedeutung für Physik, Chemie, Technik und Biologie. Leipzig 1911. pp. viii + 388. ill. (*Recd.* 22/6/21.)

Michaelis, Leonor. Praktikum der physikalischen Chemie insbesondere der Kolloidchemie für Mediziner und Biologen. Berlin 1921. pp. viii + 160. ill. (*Recd.* 22/6/21.)

Ministry of Munitions and Department of Scientific and Industrial Research. Technical records of explosives supply 1915—1918. No. 1. Recovery of sulphuric and nitric acids from acids used in the manufacture of explosives: denitration and absorption. London 1920. pp. viii + 56. ill. 12*s*. 6*d*. net. (*Recd.* 18/6/21.)

Mitscherlich, Eilhard Alfred. Bodenkunde fur Land-und Forstwirte. 3rd edition. Berlin 1920. pp. xii + 355. ill. (*Recd.* 15/7/21.)

Nernst, Walther. Theoretische Chemie. 8th—10th edition. Stuttgart 1921. pp. xvi + 896. ill. (*Recd.* 22/6/21.)

Ostwald, Wilhelm. Physikalische Farbenlehre. Leipzig 1919. pp. xii + 259. ill. (*Recd.* 22/6/21.)

—— Die Farbenfibel. 4th—5th edition. Leipzig 1920. pp. viii + 45. ill. (*Recd.* 22/6/21.)

Planck, Max. Vorlesungen über Thermodynamik. 6th edition. Berlin 1921. pp. x + 292. (*Recd.* 28/6/21.)

Tunmann, Otto. Pflanzenmikrochemie. Berlin 1913. pp. xx + 631. ill. (*Recd.* 6/7/21.)

Washington, Library of Congress. List of references on dyestuffs chemistry, manufacture, trade. Compiled under the direction of Herman H. B. Meyer. Washington 1919. pp. 186. (*Reference.*) 5*s*. net.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Ordinary Scientific Meeting, Thursday, November 3rd, 1921, at 8 p.m., Dr. M. O. FORSTER, F.R.S., Treasurer, in the Chair.

Messrs. R. G. Smith and H. F. Green were formally admitted Fellows of the Chemical Society.

Certificates were read for the first time in favour of:

Wilson Baker, B.Sc., Beacon Field, Weston Road, Runcorn.
Cyril Herbert Birkitt, A.I.C., 21, Overdale Road, Derby.
Leslie Hubert Maurice Goring, 190, Lordship Road, Stoke Newington, N. 16.
Robert Downs Haworth, M.Sc., 221, Stockport Road, Cheadle Heath, Stockport.
William James Heasman, 58, Isledon Road, N. 7.
Leslie Oliver Kekwick, 98, Wallwood Road, Leytonstone, E. 11.
Tara Singh Mahal, The Punjab Pharmaceutical Works, Ltd., Lahore, India.
George Joseph Mascull, 42, Vestris Road, Forest Hill, S.E. 23.
Harold Mastin, B.Sc., Glossop Road, Marple Bridge, Stockport.
Gilbert Owen, 18, Gauden Road, Clapham, S.W. 4.
Harold James Plenderleith, B.Sc., 1, Aberlemno Terrace, Dundee.
Alfred John Prince, 49, Longbridge Road, New Barking, Essex.
Leslie Randal Ridgway, B.Sc., Kent Mount, Stalybridge.
Alexander Scott Russell, B.A., 22, Kidbrook Park Road, Blackheath, S.E. 3.
Charles Arthur Silberrad, B.A., B.Sc., Evron, Mayenne, France.
Charles Simpson, B.Sc., 31, Hilton Crescent, Hilton Park, Prestwich, Manchester.
Percy Fred Stoton, 66, Charrington Street, N.W. 1.
Garfield Thomas, B.Sc., 8, April Street, Chorlton-on-Medlock, Manchester.
Ian William Wark, B.Sc., 43, Vincent Square, Westminster, S.W. 1.
Birkett Wylam, B.Sc., Lockerbie, Foggy Furze, West Hartlepool.

The meeting was then adjourned, and the Informal Meeting declared open.

Ordinary Scientific Meeting, Thursday, November 17th, 1921, at 8 p.m., Sir JAMES WALKER, D.Sc., F.R.S., President, in the Chair.

The PRESIDENT referred to the loss sustained by the Society, through death, of:

	Elected.	Died.
John William Smith	Dec. 18th, 1879.	June 22nd.
John Spiller	Feb. 3rd, 1859.	Nov. 8th.
Richard Lloyd Whiteley	April 15th, 1886.	Nov. 2nd.

The following were formally admitted Fellows of the Chemical Society: Mary S. Crewdson, John F. Wilkinson, Harold Burton, and R. Lindsay Grant.

Certificates were read for the first time in favour of:

Cecil Atley Bartlett, 71, Salisbury Road, Harrow.
Henry Herbert Butterfield, Carisbrooke House, Fitzwilliam Street, Huddersfield.
Harold Pease Buttrick, A.I.C., 15, Braemar Avenue, Wood Green, N.22.
Ernest Chapman, M.Sc., 83, Roe Green, Worsley, Manchester.
J. F. Davidson, B.Sc., Isca, Princess Road, Bournemouth.
Leslie George Francis Dolley, B.Sc., Rokeby Lodge, St. Albans Road, Watford.
Jacques Coenraad Hartogs, D.Chem., Velperweg 55, Arnhem, Holland.
Douglas Norman Jackman, B.Sc., 18, West Side, Clapham Common, S.W.4.
Ruth King, M.Sc., 93, St. Leonards Road, Exeter.
Nial Patrick McCleland, M.A., Pembroke College, Cambridge.
Thomas Hosker Minton, B.Sc., Grenville, Derby Road, Farnworth, Lancs.
William James Stainer, B.A., 48, Osmond Road, Hove, Brighton.
David Steven, B.Sc., 44, Howard Street, Arbroath.
Phyllis Margaret Tookey, Combe Lodge, Duncombe Hill, Honor Oak Park, S.E.23.

The following papers were read:

"The influence of nitro-groups on the reactivity of substituents in the benzene nucleus. Part V. Heteronucleal dinitro-derivatives." By H. BURTON and J. KENNER.

"Organo-derivatives of bismuth. Part V. The stability of halogen, cyano-, and thiocyano-derivatives of tertiary aromatic bismuthines." By F. CHALLENGER and J. F. WILKINSON.

"Organo-derivatives of bismuth. Part VI. The preparation and properties of tertiary aromatic bismuthines and their interaction with organic and inorganic halogen compounds. By F. CHALLENGER and L. R. RIDGWAY.

"Researches on sulphuryl chloride. Part I. Influence of catalysts: a convenient method of chlorinating benzene." By O. SILBERRAD.

"The reaction between persulphates and silver." By G. I. HIGSON.

LECTURE.

At the Ordinary Scientific Meeting to be held on Thursday, December 8th, 1921, at 8 p.m., in the Lecture Hall of the Institution of Mechanical Engineers, Storey's Gate, S.W.1, Professor J. W. Gregory, D.Sc., F.R.S., will deliver a Lecture entitled "The Genesis of Ores."

FARADAY SOCIETY.

A meeting of the Faraday Society will be held in the Society's Rooms on Tuesday, December 13th next, at 8.15 p.m., when Professor Rankine will deliver an address and open a discussion on "The Structure of some Gaseous Molecules." The attendance of Fellows of the Chemical Society is invited.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

CHADWICK, JAMES. Radioactivity and radioactive substances. London 1921. pp. xii + 112. ill. 2*s*. 6*d*. *net*. (*Recd.* 24/10/21.)
From the Publishers : Sir Isaac Pitman & Sons.

CLARKE, FRANK WIGGLESWORTH. The constants of nature. Part V. A recalculation of the atomic weights. 4th edition, revised and enlarged. *Mem. Nat. Acad. Sci.* Vol. XVI. Washington 1920. pp. 418. (*Recd.* 5/11/21.)
From the U.S. Geological Survey.

EGYPT. *Ministry of Finance.* Report on the work of the Government Analytical Laboratory in 1920, and of the Assay Office, 1919–1920 and 1920–1921. By ALFRED LUCAS. Cairo 1921. pp. vi + 38. (*Reference.*) *P.T.* 10. From the Director.

GRANT, JAMES. Confectioners' raw materials : their sources, modes of preparation, chemical composition, the chief impurities and adulterations, their more important uses and other points of interest. London 1921. pp. viii + 173. ill. 8*s*. 6*d*. net. (*Recd.* 18/10/21.) From the Publishers : Messrs. Edward Arnold & Co.

HALE, ARTHUR JAMES. Modern chemistry, pure and applied. Vol. III. London [1921]. pp. viii + 280. ill. 16*s*. net. (*Recd.* 21/10/21.) From the Publishers : Messrs. Virtue & Co.

HODGMAN, CHARLES D., assisted by MELVILLE F. COOLBAUGH and CORNELIUS E. SENSEMAN. Handbook of chemistry and

physics: a ready-reference pocket-book of chemical and physical data. 8th edition. Cleveland, Ohio, 1920. pp. 711. (*Reference.*) 24*s*. net. From the London Publishers: Messrs. Chapman & Hall.

IMPERIAL INSTITUTE and H.M. PETROLEUM DEPARTMENT, with the co-operation of HARRY BRENAN CRONSHAW. Petroleum. (Imperial Institute Monograph on Mineral Resources.) London 1921. pp. x + 110. ill. 5*s*. net. (*Recd.* 7/10/21.)
From the Director.

JOURNAL OF INDIAN INDUSTRIES AND LABOUR. Vol. I, etc. Calcutta 1921. (Two copies.)
From the Superintendent, Government Printing, India.

LEFEBURE, VICTOR. The riddle of the Rhine: chemical strategy in peace and war. London [1921]. pp. 280. ill. 10*s*. 6*d*. net. (*Recd.* 12/10/21.)
From the Publishers: Messrs. W. Collins, Sons & Co.

LORING, F. H. Atomic theories. London 1921. pp. x + 218. ill. 12*s*. 6*d*. net. (*Recd.* 19/10/21.)
From the Publishers: Messrs. Methuen & Co.

RIDEAL, SAMUEL, and RIDEAL, ERIC KEIGHTLEY. Chemical disinfection and sterilisation. London 1921. pp. viii + 313. 21*s*. net. (*Recd.* 3/11/21.) From the Authors.

ROTHAMSTED EXPERIMENTAL STATION, LIBRARY OF. Catalogue of journals and periodicals. 1921. pp. 70. (*Reference.*) 2*s*. 6*d*. net. From the Director.

RUSSELL, EDWARD JOHN. Soil conditions and plant growth. 4th edition. London 1921. pp. xii + 406. ill. 16*s*. net. (*Recd.* 12/10/21.) From the Author.

SPENCER, JAMES FREDERICK. An experimental course of physical chemistry. II. Dynamical experiments. 2nd edition. London 1921. pp. xvi + 268. ill. 6*s*. net. (*Recd.* 20/10/21.)
From the Author.

II. *By Purchase.*

BENNETT, HUGH GARNER. Animal proteins. London 1921. pp. xiv + 288. ill. 15*s*. net. (*Recd.* 22/10/21.)

CAVENDISH, HON. HENRY. Scientific papers. Edited from the published papers, and the Cavendish manuscripts in the possession of His Grace the Duke of Devonshire. Vol. I. The electrical researches. By JAMES CLERK MAXWELL. Revised by SIR JOSEPH LARMOR. Vol. II. Chemical and dynamical. By SIR EDWARD THORPE. With contributions by CHARLES CHREE, SIR FRANK WATSON DYSON, SIR ARCHIBALD GEIKIE, SIR JOSEPH LARMOR. Cambridge 1921. pp. xxviii + 452, xii + 496. ill. £6 net. (*Recd.* 22/10/21.)

Committees on the Use of Lead in Painting. Reports of the Departmental Committees appointed to investigate the danger attendant on the use of paints containing lead in the painting of buildings and on the use of lead compounds in the painting, enamelling, and varnishing of coaches and carriages. 4 vols. London 1915–1920. pp. iv + 134, iv + 43, 73, vi + 804. 16*s*. net. (*Recd.* 26/10/21.)

Dumesny, P., and Noyer, J. Wood products, distillates and extracts. 2nd edition. Translated by Herbert Birtwhistle Stocks. London 1921. pp. viii + 357. ill. 21*s*. net. (*Recd.* 18/10/21.)

Ellis, Carleton, and Meigs, Joseph V. Gasoline and other motor fuels. [New York] 1921. pp. xx + 710. ill. £3 net. (*Recd.* 18/10/21.)

Grard, C. Aluminium and its alloys: their properties, thermal treatment, and industrial application. Translated by C. M. Phillips and Henry Wilfred Lewis Phillips. London 1921. pp. xxiv + 184. ill. 17*s*. 6*d*. net. (*Recd.* 22/10/21.)

Lind, Samuel C. The chemical effects of alpha particles and electrons. New York 1921. pp. 182. ill. 21*s*. 6*d*. net. (*Recd.* 22/10/21.)

Lucas, Alfred. Forensic chemistry. London 1921. pp. viii + 268. 15*s*. net. (*Recd.* 18/10/21.)

Mayer, Adolf. Lehrbuch der Agrikulturchemie. I. Die Ernährung der grünen Gewächse. 7th edition. Heidelberg 1920. pp. viii + 460. ill. (*Recd.* 14/10/21.)

Ministry of Munitions and Department of Scientific and Industrial Research. Technical records of explosives supply 1915–1918. No. II. Manufacture of trinitrotoluene (TNT) and its intermediate products. London 1920. pp. viii + 116. ill. 17*s*. 6*d*. net (*Recd.* 22/10/21.).

—— No. III. Sulphuric acid concentration. London 1921. pp. vi + 92. ill. 12*s*. net. (*Recd.* 22/10/21.)

Moore, Benjamin. Biochemistry: a study of the origin, reactions, and equilibria of living matter. London 1921. pp. viii + 340. ill. 21*s*. net. (*Recd.* 18/10/21.)

Myers, Victor Caryl. Practical chemical analysis of blood. [New York] 1921. pp. 122. ill. 16*s*. net. (*Recd.* 22/10/21.)

Ostwald, Wolfgang. Die Welt der vernachlässigten Dimensionen: eine Einführung in die moderne Kolloidchemie, mit besonderer Berücksichtigung ihrer Anwendungen. 5th and 6th edition. Dresden 1921. pp. xvi + 253. ill. (*Recd.* 22/10/21.)

Pauli, Wolfgang. Kolloidchemie der Eiweisskörper. I. Dresden 1920. pp. viii + 111. ill. (*Recd.* 22/10/21.)

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE BALLOT TO BE HELD AT THE ORDINARY SCIENTIFIC MEETING ON DECEMBER 15TH, 1921.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

ANDERSON, HARRY, 9, Mill Street, Oakham, Rutland. Senior Chemistry Master, Oakham School. Nat. Sci. Trip. I. Cl. 2, 1913 (Cantab.). Asst. Chem. Master, Hulme Grammar School, Manchester, 1913–14. Sen. Chem. Master, Oakham School, Rutland, 1919—. Two years in France with R.E. Special Brigade (British Gas Corps). (*Signed by*) Charles T. Heycock, A. J. Berry, F. W. Dootson.

ANTHONY, ADAM ARCHIBALD, 15, West Parade, Rhyl, N. Wales. Student. Reading for Honours Chemistry (1921) at the University College of N. Wales, Bangor. Intending following the profession of chemistry. (*Signed by*) Kennedy Orton, H. B. Watson, I. Cheer Roberts, Owen Owen.

ARNOLD, FRANCIS BARTLETT, 23, Stratford Road, Thornton Heath. Managing Director, S. F. Goss, Ltd., London, W.8. (1) Educated at Weston Boarding School, Bath. (2) Studied chemistry at the London College of Pharmacy under H. Wootton, B.Sc., Ph.C., in 1911 and continued these studies under H. Lucas, F.C.S., Ph.C., at the South of England College of Pharmacy. (3) One time Assistant Analyst at the Rio Tinto Copper Company, Ltd., Works, South Wales, under J. H. Grant, A.R.S.M. (4) Passed the Final Examination of the Pharmaceutical Society of Great Britain in 1914, the subjects including Analytical Chemistry and Physics. (5) Member of the British Pharmaceutical Conference. (6) Manufacturing chemist, charged with the analytical control of S. F. Goss, Ltd., Manufacturing Chemists and Perfumers, London, W. (7) In practice as a Clinical Analyst for six years past. (8) Advisory Chemist to the Western Tablet Co., Ltd., Manufacturing Chemists, London, W. (9) Keenly desirous of keeping in close touch with analytical and process chemistry, to attend the meetings of the Chemical Society, to receive its publications regularly, and to come into contact with its Fellows. (*Signed by*) Percy Barrs, J. Wicliffe Peck, H. Lucas, W. Bennison, A. C. V. Weston.

BAKER, WILSON, B.Sc., "Beacon Field," Weston Road, Runcorn, Cheshire. Research student in the University of Manchester. Three years in the Honours course of chemistry. 1st Class Honours June 1921. Mercer scholar, Manchester University. (*Signed by*) Harold B. Dixon, Arthur Lapworth, F. P. Burt, Frederick Challenger, Henry Stephen, J. E. Myers.

BAKR, ABU MOHAMED, 121, St. Michael's Hill, Bristol. Student. Honours B.Sc., Bristol. A. M. Bakr and J. E. King: "The Determination of the Sorption of both Solvent and Solute. Part I. Preliminary. The System: Benzene–Iodine–Charcoal," *Trans. Chem. Soc.*, 1921, **119**, 454. (*Signed by*) J. W. McBain, F. Francis, F. W. Rixon.

BARTLETT, CECIL ATLEY, 71, Salisbury Road, Harrow, Middlesex. Student. Have completed whole course for B.Sc. (Honours Chemistry), London, at the South-Western Polytechnic Institute, Chelsea. (*Signed by*) Francis Arnall, F. H. Lowe, J. C. Crocker, J. B. Coleman.

BELL, HUGH CHESTER, Guy's Hospital Medical School, S.E.1. Demon-

strator in Chemistry. M.A. (Oxon.). (*Signed by*) M. P. Appleby, D. L. Chapman, N. V. Sidgwick, C. S. Gibson.

Berry, Frederick John, 51, Reynolds Street, Neutral Bay, Sydney, N.S.W. Chemist. Six years' chemical training, Sydney Technical College. Chemist in charge laboratory, Pacific Manufacturing Co., Ltd., Sydney, eight years. Three years chemical research work, Park Pope Research Laboratory, Sydney Technical College Chemical Society. Member of Council, Sydney Technical College Chemical Society. Member of Australian Chemical Institute. Member of Society of Chemical Industry. (*Signed by*) Richard W. Challinor, Robert Grant, John A. Eastwood, Archibald D. Ollé, George Z. Du Pain.

Bhowmik, Jagadish Chandra, 72, Harrison Road, Calcutta, India. M.Sc. in chemistry. Professor in charge of the commercial analysis class of the Indian Association for the Cultivation of Science. Late research student in the College of Science, C.U., 1917–1920. Analytical and research chemist in the chemical laboratory of Messrs. Turnbull Bros. Ltd., 1920–21 (January), and technical research assistant to R. L. Datta, D.Sc., up to July 1921. Contributed to chemical science on "The Replacement of Sulphonic Groups by Halogens," *Journal of the Amer. Chem. Soc.*, February, 1921. (*Signed by*) R. L. Datta, J. Bhaduri, R. N. Sen.

Birkitt, Cyril Herbert, 21, Overdale Road, Derby. Research Student in Rubber Chemistry at Northern Polytechnic Institute, Holloway. Associate of Institute of Chemistry (by examination) April 1921. Student Demonstrator at Derby Technical College from April 1921 to August 1921. Granted a scholarship by Society of Rubber Technology at Northern Polytechnic Institute for research in rubber chemistry September 1921. (*Signed by*) T. J. Drakeley, Raymond R. Butler, A. Jamieson Walker, Philip Schidrowitz.

Bland, Frederick Maynard, 137, Parkdale Road, Plumstead, S.E.18. Assistant Metallurgist. Passed examinations at the Woolwich Polytechnic: third year Inorganic Chemistry, third year Metallurgy. Nearly six years' works experience in the analysis of metals, alloys, oils, fats, waxes, etc. (*Signed by*) H. H. Smith, A. H. Mundey, S. A. Smith, *R. L. Smith.*

Bonniksen, Cyril Wilfred, c/o Messrs. Lockett Bros., Ltd., Casilla 714, Iquique, Chile. Research Chemist. B.Sc. (London), 2nd Class Hons., 1920. Research at University College, London. At present Research Chemist, Nitrate Works, Chile. (*Signed by*) J. N. Collie, Irvine Masson, F. G. Donnan, O. L. Brady.

Booer, Joseph Roy, 7, Gabriel Street, Honor Oak Park, S.E.23. Works Chemist to the District Chemical Co., Ltd., 1, Fenchurch Avenue, E.C.3. Final B.Sc. Course at Sir John Cass Technical Institute; research work on purification of acetylene, also on electric arc welding, embodied in two patents, provisional specifications accepted. (*Signed by*) Charles A. Keane, C. S. Harman, P. C. L. Thorne, C. J. D. Gair.

Bowen, Edmund John, University College, Oxford. Lecturer in Chemistry. Formerly Brackenbury Scholar, Balliol College, Oxford. Final Honours School in Chemistry, 1920, 1st Class. (*Signed by*) H. R. Raikes, N. V. Sidgwick, D. Ll. Hammick, T. W. J. Taylor, E. Hope, S. G. P. Plant.

Brabyn, William George, 7, Livingstone Road, Battersea, London, S.W.11. Student of Chemistry. Passed Inter. B.Sc. (Chem., Phys., Mechs., Maths.) in July 1918, having passed in Chem. and Maths. previously, but failed in others. Studied for B.Sc. Chemistry Hons., Physics Subsid., at King's College, Strand, for nearly two years. Sitting for Final Hons. in October 1921. (*Signed by*) A. J. Allmand, H. T. S. Britton, Stephen R. H. Edge, S. Smiles, Arthur Fairbourne, H. W. Cremer, A. E. Caswell.

BRADLEY, ARTHUR BENJAMIN, 7A, Inglethorpe Street, Fulham, S.W.6. Chemist (assistant, works and research). With Messrs. Peek, Frean & Co., Ltd. (biscuit manufacturers), for the past eleven years, as senior assistant to Capt. R. Whymper, works and research chemist. In charge of the works laboratories during the war period 1914–18. At present investigating the preparation and properties of vegetable decolorising carbons and absorption of colouring matters (sugars), preliminary reports of which have been published in the *J.S.C.I.* and the *International Sugar Journal.* (*Signed by*) R. Whymper, James P. Ogilvie, Leonard G. Hulls.

BRAITHWAITE, FREDERICK GEORGE, c/o Messrs. Lever Bros. (S.A.), Ltd. P.O. Box 209, Durban, South Africa. Analytical Chemist (soap and glycerine expert). Present position : Chief Chemist, Lever Bros. (S.A.), Ltd., Durban. Training in Messrs. Lever Bros. laboratories. Studied at Birkenhead and Liverpool under Dr. George Tate, special prizes in chemistry at both centres. Experience in soap works, alkali works, chemical and engineering and research laboratories; assistant manager glycerine dept.; October 1910 appointed chemist new factory, Durban, S.A., now chief chemist and technical manager. Elected member South African Chemical Institute, 1915. (*Signed by*) C. D. Golding, E. A. Halm, H. H. Dodds, George Tate.

BRIDGE, JAMES, Gas Works, Elland, Yorks. Engineer and General Manager. Three years chemist to the Stretford Gas Company. Seven years asst. engineer and manager to Stretford Gas Company with charge of laboratory and control of by-products works at Gas Works. Three years works manager of Bolton Corporation Gas Dept., being responsible for all manufacturing operations, recovery and working up of by-products and benzol recovery. Contributed a paper to Manchester Junior Gas Association on the " Purification of Coal Gas " and have just completed Presidency of that Association. (*Signed by*) Ernest Hardiker, F. S. Sinnatt, D. V. Hollingworth.

BURKHARDT, GEORGE NORMAN, Hulme Hall, Victoria Park, Manchester. Research Student, Victoria University, Manchester. B.Sc. (1st Class Hons. in Chem., 1920) and Beyer Fellow of Manchester University (1921); presented thesis on the sulphuric esters of phenols for degree of M.Sc., September 1921. (*Signed by*) Arthur Lapworth, H. B. Dixon, Henry Stephen, Frederick Challenger, T. Hartley.

BUTTERFIELD, HENRY HERBERT, Carisbrooke House, Fitzwilliam Street, Huddersfield, Yorks. Research Chemist for L. B. Holliday & Co., Ltd., Dye Manufacturers, Huddersfield. Student at Royal College of Science, London, for three years. (*Signed by*) A. Clayton, Thomas E. Hull, H. W. Gorbold, S. J. Hopkins.

BUTTRICK, HAROLD PEASE, 15, Braemar Avenue, Wood Green, N.22. Chemist and Works Manager to the Blick Copier Manufacturing Co., Ltd., 1 and 2, Baden Place, Crosby Row, S.E.1. Associate of the Institute of Chemistry. Passed Intermediate B.Sc. (Lond.). Passed second and third year courses in applied chemistry at Finsbury Technical College, E.C.2 (1919–21). Two and a half years senior assistant to W. C. Young, Esq., F.I.C., F.C.S., etc. (June 1912 to November 1914). Three years articled pupil to F. W. Richardson, Esq., F.I.C., F.C.S., etc. (May 1909 to June 1912). (*Signed by*) Arthur J. Hale, H. M. Atkinson, J. E. B. Price, N. L. Matthews, Charles A. Keane.

CARR, HAROLD EBEN, Lynton, St. Augustine's Avenue, S. Croydon. Editor, *British Food Journal.* I desire to receive the *Journal*, to attend the Meetings, and to have the use of the Library. (*Signed by*) Francis H. Carr, Francis W. F. Arnaud, J. Kear Colwell.

Carter, John Stanley, Holly Farm, Farnley, Leeds. Student, the University of Leeds. Studying for Honours B.Sc. in chemistry. Date of examination, June 1922. (*Signed by*) Arthur Smithells, H. M. Dawson, W. Lowson, J. B. Cohen, M. S. Leslie.

Challenor, William Arthur Percival, "Glenwood," Alkington Road, Whitchurch, Salop. Student. M.Sc. (Birmingham) research student under the Department of Scientific and Industrial Research. Beit Fellow, Imperial College of Science and Technology, London. (*Signed by*) G. T. Morgan, H. D. K. Drew, H. Gordon Reeves, H. Burgess.

Chapman, Ernest, M.Sc., 83, Roe Green, Worsley, near Manchester. Ph.D. Research Student in Chemistry at the University, Manchester. B.Sc. (1st Class Honours in Chemistry) Manchester, 1920. Awarded Graduate Scholarship and Le Blanc medal in metallurgy, 1920. Elected Beyer Fellow, June 1921. Thesis, entitled "Experiments with *o*-Tolylphthalimide and *o*-Phthaliminobenzoic Acid, and Some Observations on the Formation of Phthalamic Acids and their Conversion into Anthranilic Acids" presented for degree of M.Sc. (*Signed by*) Harold B. Dixon, Arthur Lapworth, Henry Stephen, Frederick Challenger.

Chaumeton, Philibert Camille, 101, Castleton Road, Goodmayes, Essex. Sales Manager, Messrs. Duroglass, Fore Street, E.C.2. Analytical chemist and chemical engineer for three and a half years with Messrs. British Cellulose Co., Derby. B.Sc. (Leeds) and A.I.C. (*Signed by*) O. L. Brady, G. S. W. Marlow, J. Kenyon.

Chowdary, Parvataneny Siviah, 11, Union Street, Aberdeen. Student of chemistry Robert Gordons Technical College. Matriculated student of Madras University. Wishes to keep in touch with current chemical literature. (*Signed by*) William Maitland, R. Craven, E. G. Bryant.

Clark, Oliver Anthony Patrick, 5, Grove Lane, Kingston-on-Thames. Technical Publicity Expert. Downing College, Cambridge, 1913–14. Intercollegiate examination, Cambridge University, 2nd Class, 1914. Lieut. Special Brigade R.E. (Gas Service), 1916–19. Chemical engineer, the Newport Company, Inc., Carrolville, Wis., U.S.A., 1919–20. Samson Clark & Co., Ltd., advertising contractors, since August 1920. In charge of technical advertising. (*Signed by*) A. J. Berry, W. H. Martindale, H. N. Davidge.

Cocks, Maurice Hepburn, "The Holme," Ashtead, Surrey. Student. Third Year Student for B.Sc. Chemistry Honours at University College, London. (*Signed by*) F. G. Donnan, J. N. Collie, Irvine Masson, John Sewell.

Collins, George Ernest, 37, Marshall Road, Levenshulme, Manchester. Research Student in Chemistry. B.Sc. (Tech.). I am carrying out postgraduate research for M.Sc. (Tech.). (*Signed by*) John K. Wood, Frank Lee Pyman, F. M. Rowe.

Croft, George Henry, 13, Lowther Street, York. Chemist. Chemical student at Leeds University, three years, graduating B.Sc. 1914, M.Sc. 1915. Chemist to Messrs. H. Leetham & Sons, Ltd., Millers, York, Hull, etc. Also to the Yorkshire Pearl Barley Co., Ltd., Pocklington, and to the York Waterworks Co. (*Signed by*) Arthur Smithells, J. B. Cohen, W. Lowson, William Jago, Henry Worth, Harry B. Marston.

Davidson, John Foster, Isca, Princess Road, Bournemouth. Assistant Science Master at the Modern School, Luton, Beds. B.Sc. (Manchester). (*Signed by*) Harold B. Dixon, Arthur Lapworth, F. P. Burt, Colin Campbell, J. E. Myers, Arthur Moore.

Davies, Cecil Whitfield, 135, Copers Cope Road, Beckenham, Kent. Assistant Lecturer and Demonstrator in Chemistry, University College of

Wales, Aberystwyth. B.Sc. (Wales), 2nd Class Honours in Chemistry. A.I.C. (*Signed by*) B. Mouat Jones, C. R. Bury, L. J. Hudleston, T. Campbell James.

DAWKINS, DAVID RICHARD, "Llwyncelyn," Wern Road, Skewen, near Neath. Student at University College, Cardiff. I was admitted to the degree of B.Sc. Wales in July 1920. As a result of the examinations held at the college last month, I obtained a 2nd Class Honours in Chemistry. (*Signed by*) E. P. Perman, Claude M. Thompson, W. G. Tonner.

DICKENS, FRANK, Glenfield, Weston Road, Northampton. Research Student. 2nd Class Honours in the Natural Sciences Tripos, Parts I and II, at Cambridge (Part II in chemistry). Beginning research under Professor J. F. Thorpe at the Imperial College of Science and Technology. (*Signed by*) W. J. Pope, Charles T. Heycock, W. H. Mills, G. A. R. Kon, Jocelyn Thorpe.

DOLLEY, LESLIE GEORGE FRANCIS, "Rokeby Lodge," St. Albans Road, Watford, Herts. Research Chemist, University College, London. Student at Univ. College, London, 1913–14, 1919–21. B.Sc. (Hons. Chem.) London. "1851 Exhibition" Scholar 1921— . (*Signed by*) J. N. Collie, F. G. Donnan, Irvine Masson.

FAIRRIE, GEOFFREY, Rosslyn, Merrilocks Road, Blundellsands. Sugar Refiner. The application of chemistry, physics, and bacteriology to the refining of raw sugar. Practical experience eleven years. Desire to be elected in order to enjoy benefits of Fellowship, attend meetings, be enabled to use Library, and receive *Journal*. (*Signed by*) Alfred Potter, Edward Partington, John W. Biggart.

FAKHOURY, NAZIM, University, Edgbaston, Birmingham. Student of Chemistry. Lecturer of experimental science (chemistry), Egypt. Candidate for B.Sc. degree in chemistry. Wish to keep in touch with modern chemical literature. (*Signed by*) G. T. Morgan, H. D. K. Drew, H. Gordon Reeves, J. D. Main Smith, W. J. Hickinbottom.

FITZSIMONS, ROBERT ALLEN, 43, King Henry's Road, Hampstead, N.W.3. Analyst in the Government Laboratory, London. B.Sc. (Lond.). Nine years experience in analytical chemistry at the Government Laboratory. (*Signed by*) J. Connah, Thos. J. Cheater, W. Williamson.

FULLER, JOHN WILLIAM, 35, Chesholm Road, Stoke Newington, London, N.16. Student, taking an Honours Chemistry Course at East London College. University of London. Course completed July 1st, 1921. Inter. B.Sc. (Lond.). (*Signed by*) J. R. Partington, F. G. Pope, E. J. Weeks.

FULLERTON, PERCY JAMES, 107, Macoma Road, Plumstead, S.E.18. Assistant Metallurgist (Chemical Branch R.G. and C.F. Woolwich Arsenal). Obtained distinction in chemistry in Senior Schools Exam. Certificates in organic and inorganic chemistry and metallurgy from Woolwich Polytech. L.C.C. Evening Exhibition in Chemistry; four years' experience in metals and steels analyses. (*Signed by*) H. H. Smith, S. A. Smith, A. H. Mundey, Godfrey Melland.

GORING, LESLIE HUBERT MAURICE, 190, Lordship Road, Stoke Newington, N. Chemical Merchant, 5, Newcastle Place, Clerkenwell Green, E.C.1. Three years student in chemistry at Northampton Polytechnic Institute. Student member of the Faraday Society. Evening student in organic chemistry and analysis at Northern Polytechnic Institute. At the Northampton, I studied electro-chemistry, electro-metallurgy, engineering chemistry, and organic chemistry. Am particularly anxious to be elected so as to keep in touch with all advancements in all branches of chemistry. (*Signed by*) T. J. Drakeley, R. R. Butler, S. Field.

GRAY, WILLIAM BUCHANAN, Box 663, Johannesburg, South Africa. Director of company. Ten years chemist to Messrs. Lever Bros., Ltd., Sydney. Seven years research chemist to Messrs. Lever Bros. (S.A.), Ltd., now technical managing-director to above company's ten South African factories. Late President Natal Institute of Engineers, Late Vice-President South African Chemical Institute. (*Signed by*) A. Scott Dodd, A. Archibald Boon, John M. Guthrie.

GREENBERG, SOLOMON, 41, Frithville Gardens, London, W.12. Assistant Lecturer, Chemical Dept., Battersea Polytechnic, S.W.11. Associateship of the Institute of Chemistry (Branch E). (*Signed by*) J. Kenyon, Robert H. Pickard, Harold Hunter.

GREENWOOD, GILBERT, B.Sc., Thorn Bank, Edenfield, Manchester. Research Chemist in the Manchester University. 1st Class Honours in chemistry 1921. Working under Professor Dixon on physical properties of vapours. (*Signed by*) Harold B. Dixon, Arthur Lapworth, Frederick Challenger, F. P. Burt, Colin Campbell, Henry Stephen.

GRIFFITHS, GEORGE HERBERT, 23, Drummond Road, Hoylake, Cheshire. Mining Chemist. Senior student (third year), Liverpool University School of Chemistry. Dissertations to student meetings. Interested in the development of all branches of chemistry. (*Signed by*) E. C. C. Baly, Herbert H. Froysell, I. M. Heilbron.

GUPTA, IRESH CHANDRA, 21, Cromwell Road, S.W.7. Permanent address: 70, Municipal Office Street, Dacca, India. Research Student, Royal School of Mines, Imperial College of Science and Technology. M.Sc. in chemistry of the Calcutta University. Sometime research chemist to Bird & Co., Calcutta. Selected as Probationary Deputy Assay Master for His Majesty's Mint in India. (*Signed by*) S. N. Dhar, S. S. Deshapande, B. M. Gupta.

HAILSTONE, HAROLD JOSEPH, The Gas Works, Rochdale. Gas Works Chemist and Superintendent of Tar and Ammonia Works. Demonstrator in Chemistry Department of Technical School, Birmingham (three years). Chemist, Tar Distillation Works, West Bromwich (six years). Assistant works manager, Tar Distillation Works, West Bromwich (four years). Manager, Tar Distillation Works, Rochdale (two years). Chemist, Gas Works, Rochdale (two years). Certificates: Inorganic and Organic Chemistry, Theor. and Pract. Honours certificates in "Gas Engineering" (Medallist), "Coal Tar Distillation," "Coke and By-Products Manufacture." Contributed numerous articles to the technical Press of the gas industry relative to practical chemical laboratory and works operations, plant control, etc. (*Signed by*) T. Slater Price, Frank Collingridge, William Jackson Lund.

HALL, LESLIE, 87, College Road, Isleworth, Middlesex. Research Student, Battersea Polytechnic. B.Sc. (Lond.) (2nd Class Honours in Chemistry). (*Signed by*) Robert H. Pickard, J. L. White, J. Kenyon.

HARTOGS, JACQUES COENRAAD, Arnhem, Netherlands, Velperweg 55. Director of N.V. Nederlandsche Kunstzijdefabriek (Dutch Artificial Silk Mills) at Arnhem, Netherlands. Doctor of Chemistry. (*Signed by*) J. C. Irvine, George Barger, H. J. Backer.

HAYWOOD, PERCY CHARLES, 3, Gladstone Road, Wimbledon, S.W.19. Lecturer in Chemistry. M.Sc. (Lond.) by research. (*Signed by*) J. B. Coleman, J. C. Crocker, Francis Arnall, F. H. Lowe.

HAWORTH, ROBERT DOWNS, 221, Stockport Road, Cheadle Heath, Stockport. Research Student (Chemistry). Graduated with 1st Class Hons. Chem. B.Sc., Manchester, 1919. Mercer Scholar, Levinstein Scholar, and

Leblanc Medallist. 1920 M.Sc. Beyer Fellow. Accepted as Ph.D. student at Manchester Univ., 1921. 1851 Exhibition. "Reduction of Emulsified Nitro-Compounds," published *Trans. Chem. Soc.*, June 1921 (in conjunction with Prof. Lapworth). (*Signed by*) Harold B. Dixon, Arthur Lapworth, Henry Stephen, Frederick Challenger.

Heasman, William James, 58, Isledon Road, London, N.7. Student (East London College). Sitting for Final B.Sc. (Hons. Chem.) Internal, October 1921. (*Signed by*) J. R. Partington, F. G. Pope, F. W. Turner.

Hedges, Ernest Sydney, B.Sc., "Blenheim," Albert Avenue, Sedgley Park, Prestwich, Manchester. Research Chemist in the University of Manchester. Three years in the Honours School of Chemistry. 2nd Class Honours 1921. Researching in physical chemistry. (*Signed by*) Harold B. Dixon, A. Lapworth, J. E. Myers, Colin Campbell, F. Challenger, F. P. Burt, Henry Stephen.

Hellyer, Harold Robert, 140, Elizabeth Street, Sydney, N.S.W. Teacher of Chemistry at Sydney Technical College. Holds diplomas from Sydney Technical College in metallurgy and in mineralogy, etc., 1908. Member of the Australian Chemical Institute, etc. Was appointed chief chemist on Mt. Bulga Copper Mine, N.S.W., in 1909. Qualified to sit for mine manager's exam. in 1914, which was postponed on account of the war. Six months' intensive course at Sheffield University in chemistry of steel, etc., and metallography in 1920 (as a lieutenant in the A.I.F.). At present (and for the last fourteen months) giving lectures and practical tuition in theory and practical chemistry. (*Signed by*) Richard W. Challinor, Archibald D. Ollé, George Z. Du Pain, Arthur R. Penfold, Robert Grant.

Hindes, Gwendolen, Wesley Manse, Barlow Street, Oldham. Analytical Chemist. B.Sc. (Pharm.) Manchester. Member of the Pharmaceutical Society. (*Signed by*) Harold B. Dixon, Henry Stephen, F. P. Burt.

Hinshelwood, Cyril Norman, Balliol College, Oxford. Fellow of Balliol College, Oxford. B.A. (Oxon.), lecturer in chemistry. (Papers in *Trans.*, etc.). (*Signed by*) Thomas R. Merton, H. R. Raikes, Harold Hartley.

Hodsdon, Wilfred Alec, Springfields, Bexley, Kent. Analytical Chemist. Three years student at University Coll., London, 1918–20. One year assistant chemist (brewery) at Messrs. Barclay & Perkins, 1916–17. Six months analyst British Drug Houses, 1921. Six months student at S.W. Polytechnic, 1921. (*Signed by*) George R. Tweedie, Geoffrey Middleton, J. C. Crocker.

Hole, Stanley Reginald, 10, Ringstead Road, Catford, S.E.6. Student of Chemistry. Third year chemistry student, Royal College of Science. Two years under a F.I.C. in a works laboratory. (*Signed by*) H. F. Harwood, Jocelyn Thorpe, James C. Philip, J. N. Sugden, M. A. Whiteley.

Humphreys, Harold Reginald, 61, Somers Road, Walthamstow, E.17. Student, King's College, Univ. of London. Matriculation examination of Univ. of London with chemistry, June 1915. London intermediate science examination with chemistry, July 1916. Student at University of London, King's College, 1919–21. Honours chemistry course. Candidate for London B.Sc. Hons. Chem. 1921. (*Signed by*) Samuel Smiles, A. J. Allmand, Arthur Fairbourne.

Ingham, George, c/o Messrs. Kynochs, Ltd., Umbogintwini, Natal. Analytical Chemist. Graduate (Oxford) with 1st Class Honours in Chemistry. Associate of Institute of Chemistry. Spent several years in teaching of chemistry and for last six years have filled position of chemist (analytical) at Messrs. Kynoch's Explosive Works, S.A. Part-time lecturer in chemistry

at Technical College, Durban. (*Signed by*) H. H. Dodds, W. E. Martin, Charles D. Golding.

Isaac, Kenneth James, 42, Nicoll Road, Harlesden, N.W.10. Student (third year) at University College, London. Possessing an interest in general chemistry and being a candidate for chemistry honours at University College. (*Signed by*) F. G. Donnan, J. N. Collie, Irvine Masson.

Jackman, Douglas Norman, 18, West Side, Clapham Common, S.W.4. Research Student at University College, London. Assistant to Dr. J. N. Goldsmith, F.C.S., 1909–14. Studied at University College, London, 1919–21, and took Final B.Sc. (Hons. Chem.) in October, 1921. Also carried out research, 1920–21, which is being published. (*Signed by*) J. N. Collie, Irvine Masson, F. G. Donnan.

Kekwick, Leslie Oliver, 98, Wallwood Road, Leytonstone, E.11. Student. Final Year at University College, London. (i) Interest in chemistry. (ii) Honours student (final year) at University College, London. (iii) Three years' experience as analytical and assistant works chemist. (*Signed by*) F. G. Donnan, J. N. Collie, Irvine Masson, W. E. Garner.

King, Ruth, 93, St. Leonard's Road, Exeter. Lecturer in Chemistry, University College, Exeter. Research work at Chiswick Laboratory, Dept. Explos. Supply, M.M., 1917–19. Lecturer in chemistry, University College, Exeter, 1919— . London M.Sc. 1919 (Chemistry). (*Signed by*) Clarence Smith, J. T. Hewitt, W. H. Lewis.

Koggerman, Paul Nicolai (citizen of the Esthonian Republic), 167, Queen's Gate, S. Kensington, London, S.W.7, and University, Dorpat, Esthonia. Research Student at the Imperial College of Science and Technology (from June 1919 until July 1921). Diploma in chemistry of late Imperial Russian University of Yourjeff. Lecturer in organic chemistry at the University of Dorpat (Tartu), Esthonia. (*Signed by*) Eric Sinkinson, G. Ingle Finch, A. R. Pearson.

Le Bas, Geraldine Zarika Lee, Imperial Club, Dover Street, W.1. Biochemical Research at University College Hospital. B.Sc. (Lond.), 1st Class (chemistry) Honours. Research on specific antigenic properties of lipoids. Expenses of research being partly defrayed by grant from Dixon Fund, University of London. (*Signed by*) J. F. Spencer, H. Crompton, M. S. Crewdson.

Lee, Hubert William Henry, 24, Onslow Gardens, Wallington, Surrey. Honours Chemistry Student at Birkbeck College (University of London). Student for five years at Birkbeck College, chemistry being the principal subject. (*Signed by*) B. R. Heasman, S. Sugden, George Senter.

Levy, Charles Wentworth, 76, Wellingboro' Road, Rushden, Northants. Student, King's College, Strand. Inter.B.Sc. Now studying for B.Sc. (Hons. Chemistry) Exam. in October 1921. (*Signed by*) Samuel Smiles, A. J. Allmand, Arthur Fairbourne, S. Glasstone, L. T. M. Gray.

Low, Archibald Montgomery, "The Yews," Woodstock Road, London, W.4. Professor and Consulting Engineer, also Technical Author. Hon. Asst. Prof. at Royal Ordnance Coll., Woolwich. Asst. tech. adviser to C.A.V., Ltd., Acton. Tech. adviser to *The Motor*. Studied chemistry under Prof. Armstrong at Central Tech. College in 1909. Qualified as Associate of City and Guilds Institute (A.C.G.I.), also M.I.A.E. Author of "The Two-Stroke Engine," and originator of spectroscopic method of gas analysis for internal combustion engines. Inventor and patentee of the "Low" gas occluding acetylene plant. Inventor of the electrical method of oil comparison. Partner in Messrs. K. and A. Low in 1912, consulting analytical

and metallurgical chemists. Now technical manager to Low Engineering Co., Ltd., 92A, High Street, Kensington. Laboratory, Feltham, Middlesex. During war, officer commanding Royal Flying Corps Experimental Works (Major and twice mentioned in *Gazette*). Consulting engineer to Plauson Colloidal Process and Mill Company and now engaged upon research in connection with motion of exploding gases. Inventor of chemical smoke wireless, aerial and electro-chemical method of photo-telegraphy (Govt. secret patent). (*Signed by*) W. Gowland, E. O. Courtman, W. H. Merrett.

McClelland, Nial Patrick, Pembroke College, Cambridge. Fellow and Bursar of Pembroke College. Assistant lecturer in natural science at Pembroke College. During the war chemical adviser of a corps. Author and joint author of papers in the *Trans.* and in the *Philosophical Magazine*. (*Signed by*) H. J. H. Fenton, W. H. Mills, T. M. Lowry, A. Hutchinson.

Mahal, Tara Singh, Lahore, India. Managing Director, The Punjab Pharmaceutical Works, Ltd., Lahore. Desirous of joining the Society to keep in the closest touch with modern progress in pure chemistry in its possible technical applications to my special business. (*Signed by*) Robert N. Lennox, A. Teichfeld, Thomas T. Clarke, Edna E. Holmes.

Manning, Alexander Bernard, 102, Fordhook Avenue, Ealing Common, W.5. Research Chemist. M.Sc. (Sheffield), B.Sc. (Lond.). Formerly demonstrator in chemistry in Royal College of Science. Now Physical chemist to Adhesives Committee of the Department of Scientific and Industrial Research. (*Signed by*) H. B. Baker, J. N. Sugden, H. Ellingham.

Mascull, George Joseph, 42, Vestris Road, Forest Hill, S.E.23. Student of Chemistry. Assistant Examiner in Patent Office. Intermediate science exam. (London). Sitting for Final B.Sc. (Hons. Chem.), October 1921. (*Signed by*) Samuel Smiles, A. J. Allmand, Arthur Fairbourne.

Mastin, Harold, B.Sc., Glossop Road, Marple Bridge, nr. Stockport. Research Student in the University of Manchester. After demobilisation (with two years' army service) went through three years' course in Honours School of Chemistry, 1st Class, 1921. Engaged in research on colloid chemistry. (*Signed by*) Harold B. Dixon, Arthur Lapworth, F. P. Burt, Frederick Challenger, Henry Stephen, Fred Fairbrother.

Middleditch, John Henry, 15, Fonthill Road, Hove, Brighton. Student. I am studying for an Honours Degree in Chemistry at the University of London and have already passed the Intermediate B.Sc. I propose to take up chemistry as a profession and wish to keep in touch with all the modern developments of the science. (*Signed by*) Henry B. Mackie, W. W. Reeve, Dudley Ridge.

Minton, Thomas Hosker, "Grenville," Derby Road, Farnworth, Widnes, Lancs. Research Student, Manchester University. (After January 1, 1922, Research Chemist, United Alkali Co., Ltd., Widnes.) B.Sc. (1st Class Hons.) in the Honours School of Chemistry in Manchester University. Now a research student in organic chemistry in the University. (*Signed by*) Harold B. Dixon, Arthur Lapworth, Henry Stephen, Frederick Challenger, Herbert J. Watson.

Mitchell, James Gibb, Laurelbank, Cupar, Fife. Research Chemist. Entered the University of St. Andrews in 1912 and graduated B.Sc. in July 1919, four and a half years being spent in military service. Appointed to a Carnegie Scholarship in 1919 and carried out an investigation on tetramethyl-γ-fructose which was completed in 1920. Thereafter acted as research chemist under the Fuel Research Board (Scient. and Indust. Research Dept.) (*Signed by*) J. C. Irvine, A. Killen Macbeth, R. C. Menzies.

NICKLIN, GEORGE NORMAN, 9, Willis Road, Cambridge. Engaged in research work in Chemistry, Chemical Laboratory, the University, Cambridge. M.A. (Cantab.). (*Signed by*) Hamilton McCombie, Harold A. Scarborough, R. H. Adie.

NICOL, JAMES, 12, Vectis Road, Tooting, S.W.17. Joint Managing Director and Technical Adviser. Three years physics and chemistry, Higher Grade School, Greenock. Five years physics and chemistry, Technical School, Greenock. Three years chemistry (inorganic and organic), Royal Tech. College, Glasgow. Five years laboratory assistant under W. B. Clark, F.I.C. One year works chemist at Messrs. Fairrie & Co., Ltd., Liverpool. Five and a half years chief chemist, Kestner Evaporator and Engineering Co. Certificates: Chem., physics, and maths., 1st Class Full Course Cert., Greenock Technical School. Chem., inorganic and organic, 1st Class Cert., Royal Technical College, Glasgow, under Dr. Henderson, Dr. Gray, Dr. Agnew and Dr. Wilson. Full Course Technological Cert., City and Guilds of London Institute. Sugar Manufacture, three years' course, Royal Technical College, Glasgow. 1st Class Cert. and 2nd Prize, Bronze Medal, City and Guilds of London Institute. (*Signed by*) G. S. Heaven, George Stanley Walpole, Leslie O'Brien.

ODÉN, IVEN LUDWIG ALEXANDER, Stockholm, Sweden. Professor of Chemistry. Formerly of the University of Upsala; now Professor of Chemistry, University of Stockholm. Has published many important papers on colloid chemistry. Is desirous of publishing scientific papers in the *Journ. of the Chem. Soc.* (*Signed by*) F. G. Donnan, J. N. Collie, Irvine Masson, W. E. Garner.

OWEN, GILBERT, 18, Gauden Road, Clapham, S.W.4. Works Manager to the Ajax Chemical Works. Many years manager of chemical works. Research on industrial chemical products. (*Signed by*) H. Drake Law, F. Mollwo Perkin, A. J. Hale.

PEAKE, JOHN GRIFFITH, Erskine, Prospect Road, Summer Hill, Sydney, Australia. Student (Chemistry), Royal College of Science (Diploma). Associate of the Royal College of Science. (*Signed by*) James C. Philip, Jocelyn Thorpe, G. A. R. Kon, A. E. Mitchell.

PICKERING, JOHN ROBERT, 113, Mayola Road, Lower Clapton, N.E.5. Student. Inter. B.Sc. Internal student of King's College, London. Taking B.Sc. (Hons. Chem. Course) for October 1921. Two years as assistant chemist in Government laboratory. (*Signed by*) Samuel Smiles, A. J. Allmand, Stephen R. H. Edge, Arthur Fairbourne.

PLENDERLEITH, HAROLD JAMES, 1, Aberlemno Terrace, Dundee. Research Student, Univ. Coll., Dundee. B.Sc. (St. Andrews). (*Signed by*) Alex. McKenzie, J. C. Irvine, John S. W. Boyle.

PRINCE, ALFRED JOHN, 49, Longbridge Road, New Barking, Essex. Student. Completed three years' course in chemistry at the East London College, University of London, June 1921. (*Signed by*) J. R. Partington, F. G. Pope, S. H. Woolhouse.

RATCLIFFE, NORMAN, Hamilton, New Zealand. Chief Chemist, Glaxo Manufacturing Co., N.Z. Fellow of the Institute of Chemistry. Over twenty years' experience in analytical and industrial chemistry. (*Signed by*) F. J. Bloomer, H. Jephcott, A. L. Bacharach.

READE, THOMAS HAROLD, 118, Tettenhall Road, Wolverhampton. Research Chemist. *Trans. Chem. Soc.*, 1914, "Condensations of Cyanohydrins." Student demonstrator in Cambridge University chemical laboratories for two years, and Research Exhibitioner of Emmanuel College. B.A.

Cantab.), M.Sc. (Birmingham), A.I.C. (*Signed by*) Hamilton McCombie, W. H. Mills, A. E. Cashmore.

REVERSON, WILLIAM, Philomel, Pelham Road, Bexley Heath, Kent. Now in the final year of a course for the B.Sc. (Honours Chemistry) at the East London College (Univ. of London). Scientific training obtained at: (1) Simon Langton Boys' School, Canterbury, (2) Islington Teachers' Training College, (3) Dartford Technical School, (4) Woolwich Polytechnic, (5) East London College (Univ. of London). Certificated teacher of the Board of Education. Recently teacher of chemistry at the Dartford Grammar School. (*Signed by*) F. G. Pope, R. W. Jukes, E. J. Weeks.

RIDGWAY, LESLIE RANDAL, Glent Mount, Stalybridge. Research Student. B.Sc. (2nd Class Honours Chemistry), Victoria University, Manchester. One year's research work under the supervision of Dr. F. Challenger. Results communicated to the Society in the form of a paper entitled "Organo-derivatives of Bismuth," Part VI. (*Signed by*) Arthur Lapworth, John F. Wilkinson, Frederick Challenger, J. E. Myers, Henry Stephen.

ROBERTS, HUGH MEDWYN, Hendy, Crescent Road, Rhyl. Assistant Lecturer and Demonstrator in Chemistry in the University College of Wales, Aberystwyth. B.Sc. (Wales) with 1st Class Honours in chemistry. A.I.C. (*Signed by*) B. Mouat Jones, T. Campbell James, G. T. Morgan, L. J. Hudleston, C. R. Bury.

RUDGE, ERNEST ALBERT, 21, Syr David's Avenue, Cardiff. Lecturer in Chemistry, Cardiff Technical College. B.Sc. (1st Hons. Chem.) London, 1915. A.I.C. 1917. Analytical work (technical) with Osram-Robertson Lamp Works, London, W.; Johnson & Sons, Metallurgists, London, E.C., and Morgan Crucible Co., Battersea, S.W. Engaged in analytical and research work in connection with Gas Warfare, Central Laboratory, B.E.F. (*Signed by*) F. G. Donnan, B. Mouat Jones, Harry W. Webb.

RUELL, DAVID ARTHUR, 17, Thornton Street, West Hartlepool. Research Student in Chemistry. B.Sc. (1st Class Honours in Chemistry) Dunelm. Fellow of Armstrong College. I desire to keep abreast with the recent literature on my subject. (*Signed by*) W. N. Haworth, G. C. Leitch, C. F. Allpress.

RUSSELL, ALEXANDER SCOTT, 22, Kidbrook Park Road, Blackheath, S.E.3. Research Chemist with British Glass Industries, Ltd. B.A. (Chemistry) Natural Sciences Tripos, Part II, Cambridge. Studied chemistry 1912–14 Edinburgh University. (*Signed by*) Alexander Scott, James C. Philip, C. R. Young, Arthur W. Crossley.

SACHS, LEONARD, Box 969, Pretoria, South Africa. Chemist and Druggist (South Africa) for the past eight years. I am interested in the modern developments of chemistry, and should like to be in close touch with the Society. (*Signed by*) Alfred Thomas, Jules Cofman-Nicoresti, Chas. Morton.

SAIKIA, KASINATH, "Elvestone," Shillong, Assam. Works Manager of The Assam Paper Mills, Ltd. B.A. (*a*) Graduate of the Calcutta University, India. (*b*) As chemist to Messrs. Jamal Bros., Ltd., of Rangoon, manufactured commercial caustic soda from soap sand available in Burma, and also commercial caustic potash from wood ash. (*c*) As paper expert to Messrs. Jamal Bros., Ltd., erected and worked the paper pulp plant, manufacturing paper pulp out of bamboos and Savannah grasses on a commercial basis. (*d*) Patentee (No. 6226 of 1920) of an invention for "attachment" for machines for making cardboard and the like. (*Signed by*) P. C. Rây, Chuni Lal Bose, R. L. Datta.

SAUNDERS, HORACE LEONARD, 177, Chepstow Road, Newport, Mon. At present carrying out Research Work in Chemistry at the University College, Cardiff. B.Sc. (Wales). 1st Class Honours in chemistry. A.I.C. Research work on "The Decomposition of Ammonium Nitrate by Heat" about to be forwarded for publication. (*Signed by*) Claude M. Thompson, E. P. Perman, A. A. Read.

SCHOTZ, SCHACHNO PEISACH, "Ivanhoe," 112, Wellington Road, South, Hounslow. Research and Manufacturing Chemist. D.Sc.Tech. (Zurich), B.Sc. (Hon., London), F.I.C., A.R.T.C. (Glasgow). Published a thesis, and jointly papers in the *Journal of the Chemical Society*, *Journal of the Soc. of Chem. Industry*, and *Berichte*. (*Signed by*) Francis H. Carr, Percy E. Spielmann, G. G. Henderson.

SHARP, THOMAS MARVEL, 62, Longley Road, Harrow-on-the-Hill. Research Chemist. B.Sc.Tech. (Manc.). A.I.C. Research chemist at the Wellcome Chemical Research Laboratories. (*Signed by*) T. A. Henry, William Herbert Gray, H. Paget.

SHILLING, WILLIAM GEORGE, The Mill, Preston Village, Faversham, Kent. Student. Final Honours Degree student of chemistry, having taken the Intermediate Examination in 1916. (*Signed by*) J. R. Partington, F. G. Pope, R. W. Jukes.

SILBERRAD, CHARLES ARTHUR, United Provinces, India; Evron, Mayenne, France. Indian Civil Service. (Actual official substantive appointment, "Magistrate and Collector, 1st grade.") B.A., Cambridge (1st Class Nat. Science Tripos). B.Sc., London (I.C.S. First in open examination and Bhaunagar medallist). President, Weights and Measures Committee, India, 1913–14. Author of "Monograph on Cotton Fabrics of N.W.P." (Government Press, Allahabad). Having been in India for the past twenty-seven years and a member of the Indian Civil Service, I have had no opportunities for doing any practical work; but have always been much interested in chemistry and have done what was possible to keep up my knowledge by reading. I hope to retire within a year or two and so wish to join the Society. (*Signed by*) Oswald Silberrad, E. C. C. Baly, J. T. Hewitt.

SIMPSON, CHARLES, B.Sc., Assoc. M.C.T., 31, Hilton Crescent, Hilton Park, Prestwich, Manchester. Research Student, Manchester University. Associateship course in general chemical technology, Manchester College of Technology. Three years Honours School of Chemistry, Manchester University. 1st Class Honours 1921. Joint author of "Estimation of Nitrobenzene," *J. Chem. Ind.* (*Signed by*) Harold B. Dixon, Arthur Lapworth, F. P. Burt, Frederick Challenger, Henry Stephen.

SIMPSON, FRED. WOOLER, Cheapside, Spennymoor. Chief Chemist to Messrs. Pease & Partners, Collieries and Chemical Works, Eldon, Bishop Auckland. Jan. 1908—Aug. 1914, assistant chemist, Weardale Steel, Iron, Coal, & Coke Co., Spennymoor, Durham. Sept. 1914—Feb. 1916, 18th Durham L. I., H.M. Forces. Feb. 1916—Aug. 1917, M. Munitions, Explosive and Chemical Products, Dovercourt, Essex—Chemist in charge of nitration and water purification of tetryl (S. Baldwin, M.Sc., F. O. Rice, D.Sc.); Aug. 1917—March 1918, M. Munitions, chief assistant chemist, Redbourne Hill Steel Iron, Coal, & Coke Co., Scunthorpe, Lincoln (E. C. Broomhead, M.Met.), March 1918—, chief chemist, Pease & Partners, Eldon Group, Bishop Auckland. (*Signed by*) J. E. Grainger, Arthur Marsden, L. Orange, *N. D. Ridsdale, C. H. Ridsdale, Ernest W. Jackson.*

SIRMAN, WALTER WILLIAM, 222, Reddings Lane, Hall Green, Birmingham. Lecturer in Chemistry at the Technical School, Handsworth,

Birmingham. B.Sc. (Lond.). (*Signed by*) T. Slater Price, W. E. Harrison, E. L. Rhead.

Smith, Lennart, Lund, Sweden. Present address: Chem. Laboratory, University College, London. Dr. Phil. Reader to the University at Lund. Assistant to the Chem. Laboratory, Lund, 1910–17; Dr. Phil. 1917. Reader since 1917. Publications in *Zeitschr. Physik. Chemie* (6), in *Journ. prakt. Chemie* (2), in *Zeitschr. analyt. Chemie* (1). Several Swedish publications. (*Signed by*) F. G. Donnan, J. N. Collie, Irvine Masson, W. E. Garner.

Stainer, William James, 48, Osmand Road, Hove, Sussex. Headmaster Municipal Secondary School for Boys, Brighton. B.A. (Lond.). Fellow of the Chemical Society, 1897–1904. Formerly teacher of chemistry and mathematics in this school. Author of "Synopsis of Advanced Chemistry," "Notes on Physiography," "Junior Practical Mathematics," "Graphs in Maths. and Science." (*Signed by*) W. W. Reeve, H. B. Mackie, M. C. Clutterbuck.

Steven, David, 44, Howard Street, Arbroath, Forfarshire, Scotland. Assistant in Department of Physiology, University College, Dundee. B.Sc. (pure science) of St. Andrews University. (*Signed by*) J. C. Irvine, Alex. McKenzie, John S. W. Boyle.

Storer, George Paterson, 48, Llanthewy Road, Newport, Mon. Analytical Chemist. Articled pupil for two years to J. A. Hatfield, F.I.C., F.C.S. Assistant chemist (chief assistant from May 1916 to May 1919) from May 1916 to October 1919 at Messrs. J. Lysaght, Ltd., Newport, Mon. Applied science student at University College, Cardiff, sessions 1919–21. A.I.C. (*Signed by*) E. P. Perman, A. A. Read, C. M. Thompson, J. A. Hatfield, Cecil H. Desch.

Stoton, Percy Fred, 66, Charrington Street, London, N.W.1. Student. I have completed the three years' course in chemistry at East London College. (*Signed by*) J. R. Partington, F. G. Pope, F. W. Turner.

Swan, Enoch, 129, Liverpool Road, Birkdale, Southport. Physical Chemist, Cotton Research Association, Manchester. B.Sc. with 1st Class Honours in Chemistry at the Victoria University of Manchester. One year's research in colloidal chemistry. Appointed physical chemist, Cotton Research Association, Shirley Institute, Manchester, 1921. (*Signed by*) Harold B. Dixon, F. P. Burt, J. E. Myers, Fred Fairbrother, Colin Campbell, W. W. Adamson.

Thomas, Garfield, B.Sc., 8, April Street, Chorlton-on-Medlock, Manchester. Research Student in the Chemical Laboratories, Manchester University. 1st Class Honours chemistry, 1921. (*Signed by*) Harold B. Dixon, Arthur Lapworth, F. P. Burt, Frederick Challenger, Henry Stephen.

Thomas, Walter, 24, Richborough Road, Cricklewood, N.W.2. Practising Analyst. I am now engaged on original research work in connexion with pathological chemistry. My partner and I have recently succeeded in preparing colloidal argentum and cuprum, sulphur, iodine, manganese, etc., by an entirely new and advantageous method. Use of Library. (*Signed by*) John N. Vowler, H. M. Spiers, F. J. Kettel.

Tookey, Phyllis Margaret, Combe Lodge, Duncombe Hill, Honor Oak Park, S.E.23. Student. Research student, University College, London. (*Signed by*) J. N. Collie, F. G. Donnan, Irvine Masson.

Tucker, Stanley Horwood, Lincoln College, Oxford. Researcher engaged in Organic Chemical Research at the University of Oxford. Four years' experience in the Government Laboratory under Sir James J. Dobbie, F.R.S.; three years research work with Professor W. H. Perkin, F.R.S. Recently appointed lecturer in organic chemistry to the University of Glasgow.

Publications, T., 1916, **109**, 690; 1918, **113**, 140; 1921, **119**, 216. (*Signed by*) W. H. Perkin, E. Hope, Thos. H. Durrans.

USHERWOOD, EDITH HILDA, 10, Holly Park Gardens, C. E. Finchley, N.3. Research Student at Imperial College of Science and Technology. Scholar at Royal Holloway College, 1916–20. Gilchrist Scholarship and Neil Arnott Medal for chemistry, 1918. 1st Class B.Sc. Hons. (Chemistry), 1920. (*Signed by*) M. A. Whiteley, T. S. Moore, Jocelyn Thorpe.

VARLEY, WILLIAM MANSERGH, 7, Preston Park Avenue, Brighton. Principal of the Brighton Technical College. M.A. (Cantab.), D.Sc. (Manchester and Leeds), Ph.D. (Strasbourg). Previously Principal of the Swansea Technical College, director of technical instruction for Devonport, assistant professor of physics and electrical engineering at the Heriot-Watt College, Edinburgh. Author of "On the Photo-electric Discharge from Metallic Surfaces in Different Gases," *Trans. R. Soc. Lond.*, 1903; "On the Influence of Temperature on the Photo-electric Discharge from Platinum," *Proc. R. Soc. Edin.*, 1907 (in conjunction with F. Unwin, B.Sc.); "On the Absorption of Ultra-violet Light in Different Gases," *Proc. Camb. Phil. Soc.*, 1904, and other papers of purely physical interest. (*Signed by*) M. C. Clutterbuck, W. W. Reeve, Henry B. Mackie.

VERMA, PANNA LAL, Lahore (India). Student, Electrical Engineering Class, St. Andrews University. B.Sc. (pure science), Punjab University. (*Signed by*) Edwin Theodore Dean, J. C. Irvine, V. S. Puri.

WARK, IAN WILLIAM, 43, Vincent Square, Westminster, S.W.1. 1851 Science Research Student at University College, London. B.Sc. Hons. (Melbourne). Exhibition of 1851 Science Research Scholar for Melbourne, 1921. Published (in conjunction with J. Packer, Esq., B.Sc.) a paper on "Cupritartrates" in *J.C.S.*, August 1921. Late lecturer in chemistry, Queen's College, University of Melbourne. (*Signed by*) F. G. Donnan, W. E. Garner, Irvine Masson.

WARREN, GEORGE JAMES, 28, Bavent Road, Camberwell, S.E.5. Student for Honours Chemistry Degree at Birkbeck College, University of London. Three years student at above institute, chemistry chief subject. Two years' previous laboratory experience. (*Signed by*) B. R. Heasman, S. Sugden, George Senter.

WATSON, BERTRAM THOMAS, 36, Coopersale Road, Lower Clapton. N.E. Analytical Chemist and Lecturer's Assistant. Student, City of London College, 1909–13. Assistant analyst, National Alloys, Ltd., Ilford, 1913–16. Chief analyst, National Alloys, Ltd., 1916–20. Assistant to Mr. A. W. Bain, B.A., B.Sc., F.I.C., F.C.S., and Mr. Duly, M.A. (Cantab.), 1920 to present time, City of London College, Moorfields, E.C. (*Signed by*) A. E. Garrett, Alex. W. Bain, E. J. Jackman.

WHITFEILD, BERNARD WYNDHAM, Gordon College, Khartoum. Assistant Government Chemist, Sudan Government Laboratories, Khartoum. A.I.C. Desires the literature of the Society. (*Signed by*) T. A. Henry, Saml. S. Pickles, Ernest Goulding.

WILKIE, (Rev.) JAMES GEORGE, 11, Luxemburg Gardens, Brook Green, W.6. Clerk in Holy Orders. Chemistry and Physics Master at St. Paul's School, W.6. Registered as a schoolmaster under the Registration Council. Keenly interested in modern developments of chemistry and anxious to keep in touch with recent work and to avail myself of the Society's lectures and publications. (*Signed by*) Leslie N. Brown, E. V. Evans, George Newbery.

WILKINSON, JAMES HENRY, 18, Stockton Road, Sunderland. Science Teacher. Upper Std. School and P.T. Centre, Seaham Harbour, Durham.

I desire to keep in touch with the progress made in chemistry and to receive the Society's Journals. Taking Hons. Chem. B.Sc. (London). (*Signed by*) C. F. Baker, P. C. L. Thorne, G. T. Moore.

WILSDON, BERNARD HOWELL, Lyallpur, Punjab, India. Indian Educational Service. M.A., B.Sc. (Oxon.). Professor of Chemistry, Government College, Lahore, 1913–17. Agricultural chemist to Government of the Punjab, 1917–21. Publications: Part authorship of various papers appearing in *Chem. Soc. Journ.*: "Studies in Soil Moisture, Part I"; "Memoir," *J. Dept. of Ag. in India* (Chemical Series), Vol. VI, No. 3; and *Annual Expt. Record of Punjab Agric. Dept.*, 1919, 1920, and 1921. (*Signed by*) N. V. Sidgwick, D. Ll. Hammick, T. W. J. Taylor.

WOODNOTH, PERCIVAL HARRY, 88, Rodenhurst Road, Clapham Park, S.W.4. Joint Principal, Westminster College of Chemistry, Pharmacy, and Botany, 190, Clapham Road, S.W.9. Pharmaceutical chemist (Member of the Pharmaceutical Society). Demonstrator, then lecturer for past seven years on chemistry at above school. Desirous of obtaining the literature, etc., on the recent advances in chemistry. (*Signed by*) H. Sampson Wills, E. Francis Smith, J. Walter E. Ross.

WYLAM, BIRKETT, Lockerbie, Foggy Furze, West Hartlepool. Research Student in Chemistry, Armstrong College, Univ. of Durham. B.Sc. (Dunelm) with Honours (II) in chemistry. I desire to keep abreast of the literature of the science. (*Signed by*) W. N. Haworth, G. C. Leitch, C. F. Allpress, J. A. Smythe.

The following Certificates have been authorised by the Council for presentation to ballot under Bye-law I (2):

ASKEW, HENRY OSCAR, "Rosthwaite," Konini Road, Riccarton, Christchurch, N.Z. Assistant Chemist with the New Zealand Refrigerating Co., Ltd. M.A. (N.Z.), 1st Class Honours in Chemistry. Thesis: "On Solubility of Calcium Carbonate in Presence of Alkali Salts and an Attempt to Determine by Electrometric Means the effect of such on the Solubility Product $[Ca^{\cdot\cdot}][CO_3'']=K$," (to be published *Trans. N.Z. Inst.* for 1921). Charles Cook Memorial Scholar (for Post-Graduate Research). (*Signed by*) George Gray, A. M. Wright.

BASS, LAWRENCE WADE, 1248, Yale Station, New Haven, Connecticut, U.S.A. Research Student in Organic Chemistry and Teaching Assistant in Freshman Chemistry, Yale University. Ph.B. (in chemistry), Yale University, 1919. Graduate student in organic chemistry at Yale University, 1919–21. Laboratory assistant in freshman chemistry, first term, 1919–20. Teaching assistant in freshman chemistry, second term, 1919–20, and school year, 1920–21. Candidate for Ph.D. in 1922. (*Signed by*) James Kendall, *H. T. Clarke, C. E. K. Mees, S. E. Sheppard.*

HARTMANN, ERNEST EDWARD, 222, Hamilton Street, Bound Brook, N.J., U.S.A. Technical Adviser to Calco Chemical Company. Zurich Cantonal Technicum, Diploma 1887. Swiss Federal Polytechnic, 1888. University of Zurich, 1889–91, private assistant to Victor Merz. 1903–1905 President, Hawaian Sugar Chemists' Assn. 1913–15. Technical expert, West India Sugar Finance Corp. 1916 to present day, technical adviser, Calco Chemical Co. Publications: A number of papers in connexion with the manufacture of cane-sugar in the *Hawaian Planter's Monthly* and in *The Sugar Cane* between 1897 and 1903. (*Signed by*) Wilder D. Bancroft, Marston T. Bogert, Thos. R. Duggan.

ADDITIONS TO THE LIBRARY OF THE CHEMICAL SOCIETY DURING THE YEAR 1920.

ABDERHALDEN, EMIL. Die Bedeutung der Verdauung für den Zellstoffwechsel. (From the *Zeitsch. Österr. Ingen. u. Archit.-Vereins*, 1911.)

—— Schutzfermente des tierischen Organismus. Berlin 1912. pp. xii + 110. ill.

—— Physiologisches Praktikum: chemische, physikalisch-chemische und physikalische Methoden. 2nd edition. Berlin 1919. pp. xii + 310. ill.

ACKERMANN, D. Uber das Vorkommen von Trigonellin und Nikotinursäure im Harn nach Verfütterung von Nikotinsäure. (From the *Zeitsch. Biol.*, 1912, **59**.)

ACZÉL, GÉZA. Ueber β-Methylnaphtalin und seine Derivate. Berlin 1913. pp. 53.

ADAMS, LEASON H. *See* WHITE, WALTER P.

ADLER, JOSEF. Zur Theorie der Gerbung. Heidelberg 1908. pp. 59.

ALBUQUERQUE, MATHEUS D'ANDRADE. Oleatos e estearatos (sabões) de alguns metaes. (From the *Revista chim. pura applic.*, 1916, [ii], **1**.)

—— Sobre uma relação entre os espectros de absorpção visiveis de alguns metaes nos seus derivados: $M^{IV}X'_4$ e $(M_2)^{VI}X'_6$ (saes de sesquioxydo). (From the *Revista chim. pura applic.*, 1916, [ii], **1**.)

—— Catálise. (From the *Revista chim. pura applic.*, 1918, [ii], **3**.)

—— A variação dos calores atomicos em funcção da temperatura. Ponta Delgada 1919. pp. 20.

AMERICAN CHEMICAL SOCIETY. Decennial index to Chemical Abstracts, volumes I—X, 1907–1916. 4 vols. Easton, Pa., 1917–1919. pp. viii + 4823 + xvi. (*Reference.*)

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Transactions. Vol. XI, 1918, etc. New York 1920+. (*Reference.*)

AMERICAN SOCIETY FOR TESTING MATERIALS. Proceedings. Vol. XIX., etc. Philadelphia 1919+. (*Reference.*)

ANSCHÜTZ, RICHARD. Friedrich August Kekulé. (From the *Allgemeinen Deutschen Biographie*, 1905, **51**.)

—— Hans Landolt. (From the *Bonner Zeitung*, 1910.)

ARMSTRONG, EDWARD FRANKLAND. The simple carbohydrates and the glucosides. 3rd edition. London 1919. pp. x + 239.

ARNOLD, JOHN OLIVER, and IBBOTSON, FRED. Steel works analysis. 4th edition. London 1919. pp. xvi + 419. ill.

ARREGUINE, VICTOR. Méthode pratique de détermination du point d'ébullition, avec des petites quantités de substance. (From the —. *Soc. Chim. Argent.*, 1919, **3**.)

ASAYAMA, CHÛAI. Experimentelle Beiträge zur Frage über die Bildung des Harnindicans. Mitt. I. und II. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1916, **1**.)

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS. The chemical industries of German Rhineland: a summary of the report of the British Chemical Mission on chemical factories in the occupied area of Germany. London 1920. pp. 29. ill.

ATACK, FREDERICK WILLIAM [Editor], assisted by LEONARD WHINYATES. The Chemists' Year Book 1920. 2 vols. London 1920. pp. viii + 1136. ill. (*Reference.*)

AUSTRALIA, COMMONWEALTH OF. *Institute of Science and Industry.* Bulletin No. 14. An investigation of the "Marine Fibre" of *Posidonia australis.* By JOHN READ and H. G. SMITH. Melbourne 1919. pp. vi + 60. ill.

BARKER, GEORGE FREDERICK. Memoir of Frederick Augustus Genth. Read before the American Philosophical Society, December 6th, 1901. pp. xiv. ill.

—— Biographical memoir of Matthew Carey Lea. 1823–1897. [With bibliography.] (From the *Washington Nat. Acad. Sci., Biog. Mem.*, 1905, **5**.) ill.

BARNETT, EDWARD DE BARRY. A text-book of organic chemistry. London 1920. pp. xii + 380. ill.

—— The preparation of organic compounds. 2nd edition. London 1920. pp. xv + 273. ill.

BASSETT, H. LL. *See* ONSLOW, MURIEL WHELDALE.

BAYLEY, FRANK. *See* SINNATT, FRANK STURDY.

BAYLISS, WILLIAM MADDOCK. The nature of enzyme action. 4th edition. London 1919. pp. viii + 190.

BEADLE, CLAYTON. *See* CROSS, CHARLES FREDERICK.

BECHHOLD, HEINRICH. Colloids in biology and medicine. Authorized translation from the 2nd German edition, with notes and emendations by JESSE G. M. BULLOWA. New York 1919. pp. xiv + 464. ill.

BECK, WALTER. Über Hydrocellulose, Acetylcellulose und die

Bestimmung des Essigsäuregehalts von Acetylcellulosen. Weida i. Thür. 1912. pp. 58. ill.

BEDFORD, DUKE OF, and PICKERING, SPENCER. Science and fruit growing: being an account of the results obtained at the Woburn Experimental Fruit Farm since its foundation in 1894. London 1919. pp. xxii + 348. ill.

BEILSTEIN'S HANDBUCH DER ORGANISCHEN CHEMIE. Herausgegeben von der Deutschen Chemischen Gesellschaft, bearbeitet von BERNHARD PRAGER und PAUL JACOBSON. Vol. II. Acyclische Monocarbonsäuren und Polycarbonsäuren. 4th edition. Berlin 1920. pp. viii + 920. (Two copies.)

BENARY, ERICH. Fortschritte der organischen Chemie vom 1. März 1911 bis 1. Januar 1912. (From *Fortschritte der Chemie*, 1912, **5**.)

BENISCHKE, GUSTAV. Die wissenschaftlichen Grundlagen der Elektrotechnik. 4th edition. Berlin 1918. pp. xvi + 655. ill.

BERGEN, JULIUS VON. Uber die Hydrierung ungesättigter Aldehyde und Ketone und deren Derivate mittels kollodialem Palladiumhydrosol als Katalysator. Karlsruhe 1913. pp. 56. ill.

BERGMANN, WILHELM. Uber der Heerabol-Myrrha. Bern 1906. pp. 63.

BEVAN, EDWARD JOHN. *See* CROSS, CHARLES FREDERICK.

BEYER, OSKAR. Ueber die Kontrolle und Herstellung von Saccharin. Zürich 1918. pp. 142. ill.

BILTZ, HEINRICH, and BILTZ, WILHELM. Ubungsbeispiele aus der unorganischen Experimentalchemie. 3rd edition. Leipzig 1920. pp. xii + 242. ill.

BILTZ, WILHELM. *See* BILTZ, HEINRICH.

BLAND, NORMAN. *See* NORTH, BARKER.

BLEULER, HANNS. Ueber einige Derivate des Iso-Cumaranons. Zürich 1911. pp. 26.

BLOCH, LIPPMANN FRIEDRICH. Studien über Rotationsdispersion und Mutarotation der Zuckerarten in Wasser, Pyridin und Ameisensäure. Berlin 1911. pp. 71.

BLOUNT, BERTRAM, WOODCOCK, WILLIAM H., and GILLETT, HENRY J. Cement. London 1920. pp. xii + 284. ill.

BLYTH, ALEXANDER WYNTER, and BLYTH, MEREDITH WYNTER. Poisons: their effects and detection. 5th edition. London 1920. pp. xxxiv + 745. ill.

BLYTH, MEREDITH WYNTER. *See* BLYTH, ALEXANDER WYNTER.

BONDI, S. Ueber Lipoproteide und die Deutung der degenerativen Zellverfettung. (From the *Wien. klin. Woch.*, 1908, **21**.)

BONE, WILLIAM ARTHUR. Cantor lectures on coal and its conservation. London 1919. pp. 27.

BOUCHONNET, A. Bismuth, étain, plomb. Paris 1920. pp. x + 376.

* BREINL, A., and YOUNG, W. J. The occurrence of lead poisoning amongst North Queensland children. (From the *Ann. Trop. Med. Parasit.*, 1914, **8**.)

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Third report on colloid chemistry. London 1920. pp. ii + 154.

BROWN, HENRY HILTON. *See* BROWN, JAMES CAMPBELL.

BROWN, JAMES CAMPBELL. A history of chemistry from the earliest times. 2nd edition edited by HENRY HILTON BROWN. London 1920. pp. xxxii + 544. ill.

BROWN, NELSON COURTLANDT. Forest products, their manufacture and use: embracing the principal commercial features in the production, manufacture, and utilization of the most important forest products other than lumber, in the United States. New York 1919. pp. xx + 472. ill.

BROWNE, W. H. The art of pyrotechny. London [n.d.] pp. 148. ill.

BRÜHL, JULIUS WILHELM. *See* BÜTSCHLI, O., and EBLER, E.

BRUNCK, OTTO. *See* WINKLER, CLEMENS.

BUCKMASTER, GEORGE A. Arthur Gamgee. (From *The Lancet*, 1909.) ill.

BÜLOW, CARL. Eine neue Theorie vom Bau chemischer Verbindungen. (Sammlung, Vol. XXV.) Stuttgart 1919.

BÜTSCHLI, O., and EBLER, E. Gedächtnisfeier für Julius Wilhelm Brühl am 5 Mai 1911. (From the *Verh. Naturhist. med. Ver. Heidelberg*, 1911, N.S. **11**.) ill.

BULLOWA, JESSE G. M. *See* BECHHOLD, HEINRICH.

BUNSEN, ROBERT. *See* CURTIUS, THEODOR.

BUREAU DES LONGITUDES. Annuaire pour l'an 1920. Paris 1920. pp. viii + 708 + 28 + 64 + 70. (*Reference.*)

BURGESS, GEORGE KIMBALL. Temperature measurements in steel furnaces. New York 1919. pp. 8.

—— Science and the after-war period. (From the *Sci. Monthly*, Feb. 1919.)

—— Govermental research. (From the *Sci. Monthly*, Oct. 1920.)

BUTLER, T. HOWARD. Beiträge zur Kenntnis des Pseudokodeins und ε-Methylmorphimethins. Jena 1909. pp. 31.

BYWATERS, HUBERT WILLIAM. Vitamines. (From *Science Progress*, 1914, **9**.) ill.

CAHEN, EDWARD, and WOOTTON, WILLIAM ORD. The mineralogy of the rarer metals. A handbook for prospectors. With a foreword by F. W. HARBORD. 2nd edition. London 1920. pp. xxxii + 246.

CAIN, JOHN CANNELL. The manufacture of intermediate products for dyes. 2nd edition. London 1919. pp. xii + 273. ill.

—— La fabrication des matières intermédiaires pour les colorants. Translated by PIERRE SALLES. Paris 1920. pp. xx + 294. ill.

—— The chemistry and technology of the diazo-compounds. 2nd edition. London 1920. pp. xii + 199.

—— *See* ROSCOE, THE RIGHT HON. SIR HENRY ENFIELD.

CANADIAN CHEMICAL JOURNAL. *See* CANADIAN INSTITUTE OF CHEMISTRY.

CANADIAN INSTITUTE OF CHEMISTRY. Canadian Chemical Journal. A Canadian journal devoted to metallurgy, electrochemistry, and industrial chemistry. Vol. IV., etc. Toronto 1920 + . (*Reference.*)

CANTOR LECTURES. *See* BONE, WILLIAM ARTHUR.

CANTRILL, T. C. Some chemical characters of ancient charcoals. (From *Archaeol. Cambrensis*, July, 1919.)

CARR, FRANCIS HOWARD. The Harrison Memorial Lecture. [Edward Frank Harrison.] London 1919. pp. 23. ill.

CARTER, H. R., Flax and its products. London 1920. pp. viii + 311. ill.

CASABURI, VITTORIO. Concia e tintura delle pelli. Milano 1913. pp. xiii + 464. ill.

CASTNER, HAMILTON YOUNG. Unveiling of a bronze tablet to the memory of Hamilton Young Castner in Havemeyer Hall, Columbia University, City of New York. (From the *Sch. Mines Quart.*, 1904, **25**.) ill.

CERAMIC SOCIETY. Transactions. Vol. 18, etc. Stoke-on-Trent 1919 + . (*For circulation.*)

CHALMERS, T. W. Paper making and its machinery: including chapters on the tub sizing of paper, the coating and finishing of art paper and the coating of photographic paper. London 1920. pp. xii + 178. ill.

CHAPTAL, JEAN ANTOINE CLAUDE. Elémens de chymie. 2nd edition. 3 vols. Paris, L'an troisième de la République [1794]. pp. civ + 270, 445, 436. (*Reference.*)

CHEMICAL ENGINEER, THE. A monthly publication of industrial chemistry. Vol. 27, No. 11—Vol. 28, No. 4. New York, Nov. 1919—Apr. 1920. (*Reference.*)

Continued as:—

CHEMICAL AGE. A consolidation of The Chemical Engineer and Chemical Age. Vol. 28, No. 5, etc. New York, May 1920 + .

CHEMICAL SOCIETY. Les progrès de la chimie en 1918. Traduction française. Paris 1919. pp. xvi + 321.

CHEMIE DER ERDE. Beiträge zur chemischen Mineralogie, Petrographie und Geologie. Edited by G. LINCK. Vol. I, etc. Jena 1914+. (*Reference.*)

CHRISTIANSEN, J. A. On the reaction between hydrogen and bromine. (From the *D.K. Danske Videnskabernes Selskab. Math. fys. Medd.*, 1919, 1.)

CHWOLSON, O. D. Sur les poids atomiques. (From the *Bull. Acad. Sci. Petrograd*, 1915.)

CIAMICIAN, GIACOMO. L'opera scientifica di Guglielmo Koerner. Milano 1910. pp. 16. ill.

CLAASSEN, H. Die Zucker-Fabrikation mit besonderer Berücksichtigung des Betriebes. 4th edition. Magdeburg 1918. pp. 367.

CLARK, WILLIAM MANSFIELD. The determination of hydrogen ions: an elementary treatise on the hydrogen electrode, indicator and supplementary methods with an indexed bibliography on applications. Baltimore 1920. pp. 317. ill.

CLASSEN, ALEXANDER. Handbuch der analytischen Chemie. I. Qualitative Analyse. 7th edition. Stuttgart 1919. pp. xii+341.

CLASSEN, ALEXANDER, and CLOEREN, H. Quantitative analysis by electrolysis. Revised, rearranged and enlarged English edition. By WILLIAM T. HALL. New York 1919. pp. xiv+346. ill.

CLAYTON, WILLIAM. Margarine. London 1920. pp. xii+188. ill.

CLÉMENT, LOUIS, and RIVIÈRE, C. La cellulose et les éthers cellulosiques, leurs applications industrielles. Paris 1920. pp. iv+356. ill.

CLIBBENS, DOUGLAS ARTHUR. The principles of the phase theory: heterogeneous equilibria between salts and their aqueous solutions. London 1920. pp. xx+384. ill.

CLOEREN, H. *See* CLASSEN, ALEXANDER.

CLOWES, FRANK, and COLEMAN, JOSEPH BERNARD. A treatise on qualitative analysis. 9th edition. London 1920. pp. xvi+400. ill.

COHN, GEORG. Geschmack und Konstitution bei organischen Verbindungen. (Sammlung, Vol. XXII.) Stuttgart 1915.

— — Die Carbazolgruppe. Leipzig 1919. pp. viii+317.

COLEMAN, JOSEPH BERNARD. *See* CLOWES, FRANK.

COLLEGIUM. *See* INTERNATIONAL ASSOCIATION OF LEATHER TRADES CHEMISTS.

COLLINS, SYDNEY HOARE. Chemical fertilizers and parasiticides. London 1920. pp. xii+273. ill.

CONJOINT BOARD OF SCIENTIFIC SOCIETIES. Metric Committee.

Report on compulsory adoption of the metric system in the United Kingdom. London [1920]. pp. 70.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION. 14th–19th Annual Reports, for 1890—1895. New Haven 1891—1896. (*Reference.*)

COOKE, JOSIAH PARSONS. *See* JACKSON, CHARLES LORING.

CROSS, CHARLES FREDERICK, BEVAN, EDWARD JOHN, and BEADLE, CLAYTON. Cellulose: an outline of the chemistry of the structural elements of plants with reference to their natural history and industrial uses. New impression with a supplement. London 1918. pp. xx + 348.

CROWTHER, JAMES ARNOLD. Ions, electrons, and ionizing radiations. London 1919. pp. xii + 276. ill.

CULLINGWORTH, CHARLES J. *See* LEECH, DANIEL JOHN.

CURTIS, A. H. Manganese ores. (Imperial Institute Monograph on Mineral Resources.) London 1919. pp. x + 118.

CURTIUS, THEODOR. Viktor Meyer. Rede, gehalten bei der Enthüllung der Viktor Meyer-Büste im grossen Hörsaale des chemischen Instituts zu Heidelberg am 21 Dezember 1901. Heidelberg 1903. pp. 32.

—— Robert Bunsen als Lehrer in Heidelberg Heidelberg 1906. pp. 68.

CUSHMAN, JOSEPHINE A. A special library for the rubber industry. (*Municipal Univ. of Akron. Faculty Studies*, No. 1.) 1920.

DANCASTER, ERNEST AUGUSTUS. Limes and cements, their nature, manufacture and use. An elementary treatise. 2nd edition. London 1920. pp. xii + 220. ill.

DARLING, CHARLES ROBERT. Pyrometry: a practical treatise on the measurement of high temperatures. London 1920. pp. xii + 224. ill.

DAVIES, G. M. Tin ores. (Imperial Institute Monograph on Mineral Resources.) London 1919. pp. x + 112.

DAVIES, LLEWELLYN JOHN. South Wales coals: their analyses, chemistry and geology. Cardiff 1920. pp. vi + 100.

DAVIS, OLIVER C. M. The use of physical constants in toxicology. (From the *Brit. Med. J.*, 1913.)

DAVIS, WILLIAM ALFRED. *See* PUSA, AGRICULTURAL RESEARCH INSTITUTE.

DEAN, REGINALD SCOTT. *See* SCHENCK, RUDOLPH.

DELACRE, MAURICE. Histoire de la chimie. Paris 1920. pp. xvi + 632. ill.

DEUTSCHE GESELLSCHAFT FÜR METALLKUNDE. *See* ZEITSCHRIFT FÜR METALLKUNDE.

DEVONSHIRE, MRS. R. L. *See* VALLERY-RADOT, RENÉ.

Dirks, Bernhard. Über das 2-Aminoflavon und dessen Derivate. Rostock 1906. pp. 47.

Ditmar, Rudolf. Die Synthese des Kautschuks. Leipzig 1912. pp. viii + 124. ill.

Doelter, Cornelio. [Editor.] Handbuch der Mineralchemie. Vol. I., etc. Dresden 1912 + .

Dolt, Maurice L. Chemical French. An introduction to the study of French chemical literature. Easton, Pa., 1918. pp. viii + 398.

Dowson, J. Emerson, and Larter, Alfred Tabois. Producer gas. 4th edition. London 1920. pp. xviii + 361. ill.

Driffield, Vero Charles. *See* Royal Photographic Society of Great Britain.

Drucker, Carl. *See* Ostwald, Wilhelm.

Duclaux, Jacques. Les colloïdes. Paris 1920. pp. viii + 288. ill.

Dür, Ernst. Beiträge zur Kenntnis der Dioxychalkone. Bern 1911. pp. 34.

Durrans, Thomas Harold. The relationship between odour and chemical constitution. (From the *Perf. and Essent. Oil Rec.*, 1919, **10.**)

—— A treatise on distillation. (From the *Perf. and Essent. Oil Rec.*, 1920, **11.**)

Eason, Alec B. Flow and measurement of air and gases. London 1919. pp. xii + 252. ill.

Ebler, E. *See* Bütschli, O.

Edwards, Charles Alfred. The physico-chemical properties of steel. 2nd edition. London 1920. pp. xii + 282. ill.

Egner, Max. Über Ortho-oxyderivate des Triphenylcarbinols. Stuttgart 1913. pp. [viii] + 40.

Egypt. *Department of Public Health.* Reports and notes of the Public Health Laboratories, Cairo. No. 3. Egyptian water supplies. Cairo 1920. pp. 106. ill.

—— *Survey Department.* Report on the work of the Government Analytical Laboratory and Assay Office, 1913—1919. By Alfred Lucas. pp. 58.

Einstein, Albert. Über die spezielle und die allgemeine Relativitätstheorie. 6th edition Braunschweig 1920. pp. iv + 84.

Errera, L. Jean-Servais Stas. (From the *Revue Belg.*, 1892.)

Escard, Jean. Les fours électriques industriels et les fabrications électrothermiques. Paris 1919. pp. viii + 652. ill.

Ewing, Sir J. Alfred. Thermodynamics for engineers. Cambridge 1920. pp. xiv + 384. ill.

Ferguson, John B The term "inversion." (From *Science*, 1919, [N.S.], **50.**)

FERGUSON, WILLIAM BATES. *See* ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN.

FERREIRA DA SILVA, A. J. A suposta salicilagem dos vinhos Portuguesses no Brasil (1900—1902). Memórias, notas e documentos. Coímbra 1919. pp. xxiv+548.

FIERZ, HANS EDUARD. Grundlegende Operationen der Farbenchemie. Zürich 1920. pp. xi+323. ill.

FISCHER, EMIL. Untersuchungen über Depside und Gerbstoffe (1908—1919). Berlin 1919. pp. vi+542.

FISCHER, FRANZ. *See* K. WILHELM INSTITUTS FÜR KOHLENFORSCHUNG.

FISHENDEN, MARGARET WHITE. *See* SCIENTIFIC AND INDUSTRIAL RESEARCH, *Fuel Research Board.*

FITZGERALD, GEORGE FRANCIS. *See* LARMOR, JOSEPH.

FONROBERT, EWALD. Das Ozon. (Chemie in Einzeldarstellungen. Vol. IX.) Stuttgart 1916. pp. x+282. ill.

FOOTE, PAUL D. *See* OPTICAL SOCIETY OF AMERICA.

FORCRAND, ROBERT DE. Cours de chimie. 2nd edition. 2 vols. Paris 1918—1919. pp. viii+437, [iv]+527. ill.

FORMÁNEK, JAROSLAV. Benzin, Benzinersatzstoffe und Mineralschmiermittel: ihre Untersuchung, Beurteilung und Verwendung. Berlin 1918. pp. vii+260. ill.

FORMÁNEK, JAROSLAV, and GRANDMOUGIN, EUGEN. Untersuchung und Nachweis organischer Farbstoffe auf spektroskopischem Wege. 2nd edition. 2 vols. Berlin 1908—1913. pp. viii+262, [iv]+366. ill. [*Wanting* II, iii.]

FRÄNKEL, SIGMUND. Die Arzneimittel-Synthese auf Grundlage der Beziehungen zwischen chemischem Aufbau und Wirkung. 4th edition. Berlin 1919. pp. viii+883.

FRANKE, HANS. Die pflanzlichen Gerbstoffe. Übersicht über Vorkommen, Eigenschaften, Gewinnung und Anwendung der wichtigeren pflanzlichen Gerbstoffe. Magdeburg [1909]. pp. 67.

FRANKLAND, SIR EDWARD. Experimental researches in pure, applied, and physical chemistry. London 1877. pp. xliv+1047. (Second copy.)

FRANZEN, HARTWIG. Über die Bildung der Aminosäuren in den Pflanzen und über die Einwirkung von Formaldehyd auf Cyankalium. (From the *Sitzungsber. Heidelberger Akad. Wiss.*, 1910, **9**.)

FREUND, IDA. The experimental basis of chemistry. Suggestions for a series of experiments illustrative of the fundamental principles of chemistry. Edited by A. HUTCHINSON and M. BEATRICE THOMAS. Cambridge 1920. pp. xvi+408. ill.

FREUNDLICH, HERBERT. Kapillarchemie: eine Darstellung der

Chemie der Kolloide und verwandter Gebiete. Leipzig [1909, reprinted 1920]. pp. viii + 591. ill.

FRIEND, JOHN NEWTON [Editor]. A text-book of inorganic chemistry. Vol. IX. Part i. Cobalt, nickel, and the elements of the platinum group. By JOHN NEWTON FRIEND. London 1920. pp. xvii + 367. ill. (*Reference.*)

FRITSCH, J. The manufacture of chemical manures. 2nd English edition. Translated by HERBERT BIRTWHISTLE STOCKS. London 1920. pp. xii + 383. ill.

FRYER, PERCIVAL JOHN, and WESTON, FRANK EDWIN. Technical handbook of oils, fats and waxes. [3rd edition.] Vol. I. Chemical and general. Cambridge 1920. pp. xii + 280. ill.

FUNK, CASIMIR. Studies on beri-beri: further facts concerning the chemistry of the vitamine–fraction from yeast. (From the *Brit. Med. J.*, 1913, **1.**) ill.

—— Über die physiologische Bedeutung gewisser bisher unbekannter Nahrungsbestandteile, der Vitamine. (From *Ergebnisse Physiol.*, 1913, **13.**) ill.

—— Studies on beri-beri. VII. Chemistry of the vitamine–fraction from yeast and rice-polishings. (From the *J. Physiol.*, 1913, **46.**)

—— Studies on pellagra. I. The influence of the milling of maize on the chemical composition and the nutritive value of maize-meal. (From the *J. Physiol.*, 1913, **47.**) ill.

—— Diät und diätetische Behandlung vom Standpunkt der Vitaminlehre. (From the *Münch. med. Woch.*, 1913, **60.**)

—— Fortschritte der experimentellen Beriberiforschung in den Jahren 1911—1913. (From the *Münch. med. Woch.*, 1913, **60.**)

—— Discussion on diseases due to deficiencies in diet. (From the *Proc. Roy. Soc. Med.*, 1913, **7.**)

—— Studies on growth: the influence of diet on growth, normal and malignant. (From the *Lancet*, 1914, **168.**) ill.

GAMGEE, ARTHUR. *See* BUCKMASTER, GEORGE A.

GANSSER, AUGUSTO. Manuale del conciatore. Milano 1913. pp. xxiv + 382. ill.

GATTERMANN, LUDWIG. Die Praxis des organischen Chemikers. 14th edition. Berlin 1919. pp. xii + 368. ill.

GAY-LUSSAC, LOUIS JOSEPH. Cours de chimie comprenant l'histoire des sels, la chimie végétale et animale. 2 vols. Paris 1833. [In chapters, each with independent pagination.] (*Reference.*)

GEDROITZ, K. K. Absorptive power of zealotic bases of soil. [n.d.] pp. 55. [In Russian.]

GEDROITZ, K. K. Estimation of zealotic silicic acid in soils. [n.d.] pp. 7. [In Russian.]

—— Saline soils and their improvement. [n.d.] pp. 16. [In Russian.]

GEGENBAUER, VIKTOR. *See* REICHEL, HEINRICH.

GENTH, FREDERICK AUGUSTUS. *See* BARKER, GEORGE FREDERICK.

*GEORGIEVICS, GEORG VON, and GRANDMOUGIN, EUGÈNE. A text-book of dye chemistry. (The chemistry of dyestuffs.) Translated from the 4th German edition (with additions) by FREDERICK ALFRED MASON. London 1920. pp. xvi + 560.

GIBBS, WILLARD. L'équilibre des substances hétérogènes. Translated with notes by GEORGES MATISSE. Paris 1919. pp. viii + 99.

GILDEMEISTER, EDUARD, and HOFFMANN, FRIEDRICH. The volatile oils. 2nd edition. Vol. II. London 1916 (published 1920). pp. xx + 686. ill.

GILLETT, HENRY J. *See* BLOUNT, BERTRAM.

GIMINGHAM, CONRAD THEODORE. English work on pasture soils. (From the *Int. Mitt. Bodenk.*, 1912, **2**.)

GOEBELL, HUGO. I. Über die Bildung von lakmusartigen Farbstoffen aus Amidoorcin. II. Über eine eigenartige Oxydation des Orcins. Erlangen 1911. pp. 32.

GRAEBE, CARL. Geschichte der organischen Chemie. Vol. I. Berlin 1920. pp. x + 406.

GRANDMOUGIN, EUGÈNE. *See* FORMÁNEK, JAROSLAV.

—— *See* GEORGIEVICS, GEORG VON.

GRASSER, GEORG. Handbuch für Gerberei-chemische Laboratorien. Leipzig 1914. pp. xvi + 396. ill.

GREEN, ARTHUR GEORGE. The analysis of dyestuffs and their identification in dyed and coloured materials, lake-pigments, foodstuffs, etc. 3rd edition. London 1920. pp. xii + 150.

GREENMAN, EDWARD D. *See* WEST, CLARENCE JAY.

GREENWOOD, HAROLD CECIL. Industrial gases. London 1920. pp. xvii + 371. ill.

GROOM, PERCY. *See* SCIENTIFIC AND INDUSTRIAL RESEARCH.

GROSSMANN, H. [Editor.] Englands Kampf um den naturwissenschaftlichen Unterricht. (Sammlung, Vol. XXIII.) Stuttgart 1917.

—— *See* HESSE, A.

—— *See* SAMTER, VICTOR.

HAAR, ANNE WILHELM VAN DER. Anleitung zum Nachweis, zur Trennung und Bestimmung der reinen und aus Glukosiden usw. erhaltenen Monosaccharide und Aldehydsäuren. Berlin 1920. pp. xvi + 345. ill.

HAAS, GUSTAV. Über die Einwirkung von Phosgen auf die

Salicylsäure und auf einige ihrer Abkömmlinge. München 1905. pp. 46.

HÄGGLUND, ERIK. Die Hydrolyse der Zellulose und des Holzes. (Sammlung, Vol. XXII.) Stuttgart 1915.

HÄUSSLER, ROBERT. Über Methylendigallussäure. München 1912. pp. 92. ill.

HAGENBACH-BISCHOFF, EDUARD. Worte der Erinnerung an Georg W. A. Kahlbaum. Basel 1905. pp. 24. ill.

HALL, SIR ALFRED DANIEL. Fertilisers and manures. London [1909, reprinted 1919]. pp. xvi + 384. ill. (Two copies.)

—— The feeding of crops and stock: an introduction to the science of the nutrition of plants and animals. London [1911, reprinted 1919.] pp. xvi + 298. ill. (Two copies.)

—— The soil: an introduction to the scientific study of the growth of crops. 3rd edition. London 1920. pp. xvi + 352. ill. (Two copies.)

HALL, SIR ALFRED DANIEL, and RUSSELL, EDWARD JOHN. A report on the agriculture and soils of Kent, Surrey, and Sussex. London 1911. pp. viii + 206. ill.

HALL, WILLIAM T. *See* CLASSEN, ALEXANDER.

HALLIBURTON, WILLIAM DOBINSON. The essentials of chemical physiology for the use of students. 10th edition. London 1919. pp. xi + 324. ill.

HARA, SHOHEI. Über die Ausscheidung der aromatischen Oxysäuren bei verschiedenen Krankheiten mit besonderer Berücksichtigung der Nephritiden. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1917, **1**.)

HARBORD, F. W. *See* CAHEN, EDWARD.

HARRIES, CARL DIETRICH. Untersuchungen über das Ozon und seine Einwirkung auf organische Verbindungen (1903—1916). Berlin 1916. pp. xii + 720. ill.

—— Untersuchungen über die natürlichen und künstlichen Kautschukarten. Berlin 1919. pp. x + 258.

HARRISON, EDWARD FRANK. *See* CARR, FRANCIS HOWARD.

HARTMANN, KONRAD. Sicherheitseinrichtungen in chemischen Betrieben. (Chem. Tech. in Einzeldarstellungen.) Leipzig 1911. pp. viii + 312. ill

HASSELBACH, ALEXANDER. Über Oxindigo und andere indigoide Verbindungen des Cumaranons. Marburg 1912. pp. 61.

HATSCHEK, EMIL. Laboratory manual of elementary colloid chemistry. London 1920. pp. viii + 135. ill.

HELD, ALBERT. Abscheidung von Aldehyden und Ketonen der Fettreihe mit *m*-Nitrobenzhydrazid oder Hydrazinhydrat aus verdünnten wässrigen Lösungen. Heidelberg 1913. pp. 54.

HELLER, GUSTAV. Ueber die Konstitution des Anthranils. (Sammlung, Vol. XXIII.) Stuttgart 1916.

HELMHOLTZ, HERMANN VON. Ansprachen und Reden gehalten bei der am 2 November 1891 zu Ehren von Hermann von Helmholtz veranstalteten Feier. Berlin 1892. pp. 63. ill.

HENDERSON, I. F., and HENDERSON, W. D. A dictionary of scientific terms . . . in biology, botany, zoology, anatomy, cytology, embryology, physiology. Edinburgh 1920. pp. viii + 354. (*Reference.*)

HENDERSON, W. D. *See* HENDERSON, I. F.

HENRY, LOUIS. Souvenir de la manifestation en l'honneur de M. le professeur Louis Henry. (7 Juin 1900.) Louvain 1900. pp. 78. ill.

HERIOT, THOMAS HAWKINS PERCY The manufacture of sugar from the cane and beet. London 1920 pp. x + 426 ill.

HERZFELD, J. The technical testing of yarns and textile fabrics. 3rd English edition. Translated by D. T. NISBET. London 1920. pp. viii + 209. ill.

HESSE, A., and GROSSMANN, H. Englands Handelskrieg und die chemische Industrie (Sammlung, Vol XXII., XXV.) Stuttgart 1915, 1917.

HISCOX, GARDNER D. [Editor]. Henley's twentieth century formulas, recipes and processes. Containing ten thousand selected household and workshop formulas. 1919 edition, revised and enlarged. New York 1919. pp. 807. (*Reference.*)

HOFFMANN, FRIEDRICH. *See* GILDEMEISTER, EDUARD.

HOFMANN, AUGUST WILHELM VON. *See* WILL, CARL WILHELM.

HOLKER, J. A method of determining several viscosities simultaneously. (From the *J. Path. Bact.*, 1920, **23**.)

—— The viscometer as a means of determining specific gravity. (From the *J. Path. Bact.*, 1920, **23**.)

HOLLEY, CLIFFORD DYER. Analysis of paint vehicles, japans and varnishes. New York 1920. pp. x + 204. ill.

HOSTETTER, J. CLYDE. *See* MERWIN, HERBERT EUGENE.

HOUZEAU, AUGUSTE. "Cinquantenaire Scientifique" de Auguste Houzeau, 24 Février 1900. Compte-Rendu du cinquantenaire. Notice sur les travaux scientifiques. (From the *Bull. Soc. Ind. Rouen*, Mai–Juin 1900.) ill.

HOYT, SAMUEL L. Metallography. Part I. New York 1920. pp. x + 256. ill.

HUBBARD, ERNST. The utilisation of wood-waste. 3rd English edition, translated from the 2nd German edition by HERBERT BIRTWHISTLE STOCKS. London 1920. pp. xii + 236. ill.

Hughes, John. The action of lime in the soil. (From the *J. Bath & W. & S. Co. Soc.*, 1919, [v], **13**.)

Hulme, E. W. [and others]. Leather for libraries. London 1905. pp. 57.

Hurter, Ferdinand. *See* Royal Photographic Society of Great Britain.

Hutchinson, A. *See* Freund, Ida.

Ibbotson, Fred. The chemical analysis of steel-works' materials. London 1920. pp. viii + 296. ill.

—— *See* Arnold, John Oliver.

Imperial Mineral Resources Bureau. First annual report, with appendix. London 1920. pp. 24.

—— The Mineral Industry of the British Empire and Foreign Countries. War Period. Arsenic. (1913—1919.) London 1920. pp. 19.

—— —— Borates. (1913—1919.) London 1920. pp. 24.

—— —— Chrome ore and chromium. (1913—1919.) London 1920. pp. 29.

—— —— Felspar. (1913—1919.) London 1920. pp. 16.

—— —— Fuller's earth. (1913—1919.) London 1920. pp. 15.

—— —— Magnesite. (1913—1919.) London 1920. pp. 42.

—— —— Monazite. (1913—1919.) London 1920. pp. 15.

—— —— Nitrates. (1913—1919.) London 1920. pp. 28.

India, Chemical Services Committee, 1920. Report. Simla 1920. pp. xii + 122.

Indian Institute of Science. Journal. Vol. I, etc. Bangalore 1914 + . (*Reference.*)

Indian Munitions Board. Industrial handbook 1919. Revised edition. Calcutta 1919. pp. iv + 417. ill. (*Reference.*)

Ingle, Herbert. A manual of agricultural chemistry. 4th edition. London 1920. pp. viii + 432. ill.

Institut für Kohlenvergasung und Nebenproduktengewinnung. Mitteilungen. Year I, etc. Wien 1918 + . (*Reference.*)

International Association of Leather Trades Chemists. Collegium. No. 138—524. 9 Vols. Frankfurt-am-Main 1905—1913. (*Reference.*)

Ipsen, Carl. Bemerkungen zur Entstehung des Fettwachses. Innsbruck 1909. pp. 52.

Iwao, Toku. Über eine neue kulturelle vitale Färbung von Bakterien. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1916, **1**.)

—— Über die experimentelle Hämosiderosis infolge der intravenösen Injektion von *p*-Oxyphenyläthylamin bei Kaninchen. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1916, **1**.)

JACKSON, CHARLES LORING, and others. Addresses in commemoration of Josiah Parsons Cooke. (From the *Proc. Amer. Acad.*, 1895, **30**.) ill.

JACOBSON, PAUL. *See* BEILSTEIN'S HANDBUCH DER ORGANISCHEN CHEMIE.

JÄRVINEN, K. K. Über die Molekularattraktion. III. Die Zustandsgleichung. (From *Ann. Acad. Sci. Fennicae*, 1919, [*A*], **12**.)

JANSSEN, JULES. Galerie des notabilités contemporaines: Janssen de l'Institut. (From the *Revue d'Europe*.) 1901. ill.

JETTMAR, JOSEF. Moderne Gerbmethoden, enthaltend verschiedene neuartige Verfahren beim Weichen, Äschern, Einfetten und Aufhellen, sowie Anleitungen zur Herstellung moderner Ledersorten. Wien 1913 pp. viii + 256. ill.

—— *See* WOOD, JOSEPH TURNEY.

JOBLING, EDGAR. Catalysis and its industrial applications. 2nd edition. London 1920. pp. viii + 144. ill.

JONES, ERNEST GABRIEL. Chemistry for public health students. London 1920. pp. x + 244.

JONES, ROBERT. [A new treatise on artificial fireworks. London 1765.] pp. xxviii + 262. ill. [Title-page missing.] (*Reference*.)

KAGEYAMA, MANJI. Experimentelle Untersuchungen über die Wirkungen von *p*-Oxyphenyläthylamin mit besonderer Berücksichtigung der Lehre von der intestinalen Autointoxikation. Mitt. I. und II. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1916, **1**.)

KAHLBAUM, GEORG W. A. Justus von Liebig und Friedrich Mohr. Eine Einleitung zu ihrem Briefwechsel. (From the *Mitt. Med. Naturwiss*, 1904, **3**.)

—— *See* HAGENBACH-BISCHOFF, EDUARD.

—— *See* MONOGRAPHIEEN AUS DER GESCHICHTE DER CHEMIE.

KAISER WILHELM INSTITUTS FÜR KOHLENFORSCHUNG IN MÜLHEIM RUHR. Gesammelte Abhandlungen zur Kenntnis der Kohle. Edited by FRANZ FISCHER. Vol. I, 1915—1916, etc. Berlin 1917 + (*Reference*.)

KEKULÉ, FRIEDRICH AUGUST. *See* ANSCHÜTZ, RICHARD.

KELVIN, LORD. James Watt. An oration delivered in the University of Glasgow on the commemoration of its ninth jubilee. Glasgow 1901. pp. 22.

—— *See* THOMPSON, SILVANUS PHILIPPS.

KENTISH, THOMAS. The pyrotechnist's treasury. The complete art of making fireworks. 2nd edition. London 1887. pp. xiv + 218. ill.

KENWOOD, HENRY RICHARD. Public health laboratory work (chemistry). 7th edition. London 1920. pp. xii + 420. ill.

KERSHAW, JOHN BAKER CANNINGTON. Fuel, water and gas analysis for steam users. 2nd edition. London 1919. pp. xii + 201. ill.

KIESER, FELIX. Ueber den basischen Einfluss des Methoxyls. Heidelberg 1913. pp. 53.

KINGZETT, CHARLES THOMAS. Popular chemical dictionary. London 1920. pp. vi + 368. ill. (*Reference.*)

KINNICUTT, LEONARD P., WINSLOW, C.-E. A., and PRATT, R. WINTHROP. Sewage disposal. 2nd edition. New York 1919. pp. xviii + 547. ill.

KLOOSTER, HENRY S. VAN. Lecture demonstrations in physical chemistry. Easton, Pa., 1919. pp. vi + 196. ill.

KÖHRES, GEORG. Uber die Einwirkung von Bromessigester und Zink auf *o*-Diketone. (Eine Synthese des Chrysens.) Giessen 1912. pp. 68.

KOERNER, GUGLIELMO. *See* CIAMICIAN, GIACOMO.

KÖRNER, TH. Beiträge zur Kenntnis der wissenschaftlichen Grundlagen der Gerberei. (From the *Jahresber. Deut. Gerberschule,* 1903.)

KOHNSTEIN, B. Chemismus und Fortschritte in der Gerberei-Technik. (From the *Oesterr. Chem.-Zeit.*, 1911.)

KRAUCH, C. Chemical reagents: their uses, methods of testing for purity and commercial varieties. Translated from the 3rd German edition. 2nd English edition, revised and enlarged by HERBERT BIRTWHISTLE STOCKS. London 1919. pp. vi + 369.

KREMANN, ROBERT. Die Eigenschaften der binären Flüssigkeitsgemische. Ein Beitrag zur Theorie der konzentrierten Systeme. (Sammlung, Vol. XXIII.) Stuttgart 1916.

KUENEN, JOHANNES PETRUS. *See* OSTWALD, WILHELM.

LANDOLT, HANS. *See* ANSCHÜTZ, RICHARD.

LARMOR, JOSEPH. George Francis Fitzgerald. (From the *Physical Rev.*, 1901, **12.**) ill.

LARTER, ALFRED TABOIS. *See* DOWSON, J. EMERSON.

LASSAIGNE, JEAN LOUIS. Abrégé élémentaire de chimie considérée comme science accessoire à l'étude de la médecine, de la pharmacie et de l'histoire naturelle. 2nd edition. 2 vols. Paris 1836. pp. xvi + 611, x + 686. ill. (*Reference.*)

LAW, EDWARD F. Alloys and their industrial applications. 4th edition. London 1919. pp. xiii + 433. ill.

LEA, MATTHEW CAREY. *See* BARKER, GEORGE FREDERICK.

LEACH, ALBERT ERNEST. Food inspection and analysis. Revised

by ANDREW LINCOLN WINTON. 4th edition. New York 1920. pp. xx + 1090. ill.

LEBLANC, NICOLAS. Statue de Nicolas Leblanc. Compte rendu de la cérémonie d'inauguration du 28 Juin 1887. Coulommiers 1887. pp. 35.

LEECH, DANIEL JOHN. Life and work of Sir William Roberts. With an appendix, containing a list of his published writings, compiled and chronologically arranged by CHARLES J. CULLINGWORTH. (From the *Med. Chron.*, 1899.) ill.

LETTERMANN, ADOLF. Beiträge zur Kenntnis aromatischer Arsine und Stibine. Rostock 1911. pp. 44.

LEWIS, FREDERICK C. On the detection and estimation of bacterial indol and observations on intercurrent phenomena. (From the *J. Path. Bact.*, 1915, **19**.)

LIDOFF, ALEXANDER PAWLOWITSCH. Concerning oxans, isomerides of carbon dioxide. (From the *Proc. 13th Cong. Russ. Naturalists and Doctors* at Tiflis, 1913.) [In Russian.]

LIEBIG, JUSTUS VON. *See* KAHLBAUM, GEORG WILHELM AUGUST.

LIERG, FRIEDRICH H. Beiträge zur Chemie des Verkokungsprozesses. Weida i. Thür. 1910. pp. 57.

LINCK, G. *See* CHEMIE DER ERDE.

LIPSCHÜTZ, H. Die Frage der künstlichen Düngung mit besonderer Berücksichtigung der Phosphorsäure-Düngung in den Nationalstaaten des ehemaligen Osterreich-Ungarn vor dem Kriege und heute. Wien 1920. pp. 70.

LITTLE, ARTHUR D. *See* WEST, CLARENCE JAY.

LLOYD, FRANCIS ERNEST. The artificial ripening of persimmons. (From the *Bull. Alab. Depart. Agric.*, 1911, **42**.)

—— The behaviour of tannin in persimmons, with some notes on ripening. (From the *Plant World*, 1911, **14**.) ill.

LLOYD, LORENZO L. Studien über Chromonderivate. Bern 1903. pp. 27.

LÖFFL, V. KARL. Die chemische Industrie Frankreichs. Eine industriewirtschaftliche Studie über den Stand der chemischen Wissenschaft und Industrie in Frankreich. (Sammlung, Vol. XXIV.) Stuttgart 1917.

LUCAS, ALFRED. Legal chemistry and scientific criminal investigation. London 1920. pp. viii + 181.

—— *See* EGYPT, *Survey Department*.

LUNGE, GEORG. Nachruf auf Victor Meyer. (From the *Vierteljahrsschrift d. Naturf. Ges. Zürich*, 1897, **42**.)

McGOWAN, GEORGE. The nitrogen in sewage. (From the *J. Inst. Sanit. Eng.*, 1920, **24**.)

McLennan, John Cunningham. Report on some sources of helium in the British Empire. Ottawa 1920. pp. viii + 72. ill.

Malatesta, G. Coal-tars and their derivatives: the production of tars from gas coals, coke ovens, water gas, oil gas, lignite, wood and peat; the manufacture of pitch, asphalt, and bitumen; and the chemical examination and analysis of the raw materials and bye-products of the industry. Translated . . . with additions. London 1920. pp. xii + 530. ill.

Marshall, Arthur. Dictionary of explosives. London 1920. pp. xiv + 160. (*Reference.*)

Martin, Geoffrey. Animal and vegetable oils, fats, and waxes . . ., including the manufacture of candles, margarine and butter. London 1920. pp. x + 218. ill.

Martindale, William Harrison, and Westcott, W. Wynn. The extra pharmacopœia. 17th edition. Vol. I. London 1920. pp. xl + 1115. (*Reference.*)

Mason, Frederick Alfred. *See* Georgievics, Georg von.

Masters, Helen. *See* Tinkler, Charles Kenneth.

Matisse, Georges. *See* Gibbs, Willard.

Matthews, J. Merritt. Application of dyestuffs to textiles, paper, leather and other materials. New York 1920. pp. xvi + 768. ill.

Mees, Charles Edward Kenneth. The organisation of industrial scientific research. New York 1920. pp. x + 176.

Megraw, Herbert A. The flotation process. 2nd edition. New York 1918. pp. xii + 359. ill.

Meldola, Raphael. Chemistry. (Home University Library.) London [1913]. pp. 255.

Meldrum, Andrew Norman. The development of the atomic theory. London [n.d.]. pp. 13.

Merica, P. D. A simplification of the inverse-rate method for thermal analysis. (*Sci. Papers of the Bureau of Standards*, No. 336, 1919.)

Merwin, Herbert Eugene, and Hostetter, J. Clyde. Hematite and rutile formed by the action of chlorine at high temperatures. (From the *Amer. Min.*, 1919, **4**.)

Metal Industry, The: an illustrated weekly journal dealing with the non-ferrous metals. Vol. 15. No. 21, etc. London, Nov. 21, 1919 + . (*Reference.*)

Meyer, Victor. *See* Curtius, Theodor.

—— *See* Lunge, Georg.

Miłobędska, Janina. Zur Kenntnis des Curcumins. Zürich 1911. pp. 44.

MINISTRY OF AGRICULTURE AND FISHERIES. **Damage to fisheries by pollution.** London 1920. pp. 6.

MINISTRY OF MUNITIONS. *Department of Explosives Supply.* Preliminary studies for H.M. Factory Gretna, and Study for an installation of phosgene manufacture. London [1920]. pp. xvi + 145. ill.

—— *Munitions Inventions Department.* Nitrogen Products Committee. Final report. London 1919. pp. vi + 357. ill. (Two copies.)

MIRKIN, ABRAM. Zur Kenntnis des Brasilins. Bern 1909. pp. 28.

MITO, TOKIO. Über die asymmetrische Spaltung der razemischen Polypeptiden durch abgetötete Bakterien. Mitt. I. (From the *Act. Schol. Med. Univ. Imp., Kioto,* 1917, **1**.)

MITTER, PROFULLA CHANDRA. Ueber Carboxylierung einiger fettaromatischer Kohlenwasserstoffe mittels Oxalylchlorid. Berlin 1912. pp. 39.

MOHR, FRIEDRICH. *See* KAHLBAUM, GEORG WILHELM AUGUST.

MOIR, JAMES. Colour and chemical constitution. Parts IV to IX. (From the *Trans. Roy. Soc. S. Africa,* 1919—1920, **7—8**.)

MOISSAN, HENRI. Hommage au professeur Henri Moissan. 22 Décembre 1906. Paris. pp. 22. ill.

MOLINARI, ETTORE. Treatise on general and industrial inorganic chemistry. 2nd edition, translated from the 4th Italian edition by THOMAS HENRY POPE. London 1920. pp. xx + 876. ill.

MONOGRAPHIEEN AUS DER GESCHICHTE DER CHEMIE. Edited by GEORG WILHELM AUGUST KAHLBAUM. I—VIII. Leipzig 1897—1904. ill.

MORTIMER, G. W. Pyrotechny; or, a familiar system of recreative fire-works. 2nd edition. London [1824]. pp. xvi + 126. ill.

MOUREU, CHARLES. Notions fondamentales de chimie organique. 6th edition. Paris 1919. pp. viii + 552. ill.

MÜLLER, WILHELM. Zur Kenntnis der Farbstoffe des Gelbholzes. Bern 1907. pp. 75.

NASKE, CARL. Zerkleinerungsvorrichtungen und Mahlanlagen. (Chem. Tech. in Einzeldarstellungen.) 2nd edition. Leipzig 1918. pp. x + 278. ill.

NAUMANN, OTTO. Über den Gerbstoff der Pilze. Dresden 1895. pp. 46.

NAUMANN, WILHELM. Über die Oxydation von Chinaalkaloiden zu Ketonen. Jena 1909. pp. 41.

NEVILLE, HENRY ALLEN DUGDALE. *See* NEWMAN, LESLIE FRANK.

NEWMAN, LESLIE FRANK, and NEVILLE, HENRY ALLEN DUGDALE. A course of practical chemistry for agricultural students. Vol. I. and II.i. Cambridge 1920, 1919. pp. 235, 122.

NIERENSTEIN, MAXIMILIAN. Report on the excretion of quinine in the urine. London 1919. pp. 80. ill.

NISBET, D. T. *See* HERZFELD, J.

NORTH, BARKER, and BLAND, NORMAN. Chemistry for textile students: a manual suitable for technical students in the textile and dyeing industries. Cambridge 1920. pp. viii + 379. ill.

NOYES, WILLIAM ALBERT. Organic chemistry for the laboratory. 3rd edition, revised and enlarged. Easton, Pa., 1916. pp. xii + 292. ill.

ONSLOW, MURIEL WHELDALE. Our present knowledge of the chemistry of the Mendelian factors for flower-colour. II. (From the *J. of Genetics*, 1915, **4**.)

—— Practical plant biochemistry. Cambridge 1920. pp vi + 178.

ONSLOW, MURIEL WHELDALE, and BASSETT, H. LL. On a supposed synthesis of anthocyanin. (From the *J. of Genetics*, 1914, **4**.)

OPTICAL SOCIETY OF AMERICA. Journal. Edited by PAUL D. FOOTE. Vol. IV, etc. Philadelphia 1920 + . (*Reference.*)

OSLER, SIR WILLIAM. *See* VALLERY-RADOT, RENÉ.

OST, H. Lehrbuch der chemischen Technologie. 10th edition. Leipzig 1919. pp. viii + 790. ill.

OSTERHOUT, WINTHROP JOHN VANLEUVEN. A simple method of demonstrating the production of aldehyde by chlorophyll and by aniline dyes in the presence of sunlight. (From the *Amer. J. Bot.*, 1918, **5**.)

—— Apparatus for the study of photosynthesis and respiration. (From the *Bot. Gaz.*, 1919, **68**.) ill.

OSTWALD, WILHELM, and DRUCKER, CARL [Editors]. Handbuch der allgemeinen Chemie. I. Die chemische Literatur und die Organisation der Wissenschaft. By WILHELM OSTWALD. III. Die Eigenschaften der Gase. Kinetische Theorie. Zustandsgleichung. By JOHANNES PETRUS KUENEN. Leipzig 1919. pp. [viii] + 120, viii + 448. ill. (*Reference.*)

OTSUKA, ICHIRO. Über den Abbau einiger Polypeptide durch Bakterien. Mitt. IV. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1916, **1**.)

OTT, ERWIN. Neuere Untersuchungen über Laktone (1907—1915). (Sammlung, Vol. XXVI.) Stuttgart 1920.

PALMAER, WILHELM. Elektrolyse von Kochsalzlösungen in Verbin-

dung mit der Zelluloseindustrie. (Sammlung, Vol. XXIII.) Stuttgart 1916.

PELLINI, GIOVANNI. Über das Atomgewicht des Tellurs und seine Beziehungen zu den Gruppenhomologen. Deutsch von BARTOLO LINO VANZETTI. (Sammlung, Vol. XXI.) Stuttgart 1914.

PETSCHEK, ERNST FRIEDRICH. Einige neue Benzpyrone und ihre Bildung aus Phenolen und β-Ketonsäureestern. (Eine neue Chromonsynthese.) Berlin 1912. pp. 62.

PHILLIPS, FRANCIS C. Chemical German. An introduction to the study of German chemical literature: including rules of nomenclature, exercises for practice and a collection of extracts from the writings of German chemists . . . and a vocabulary of German chemical terms and others used in technical literature. 2nd edition. Easton, Pa., 1915. pp. viii + 252.

PICKERING, SPENCER. *See* BEDFORD, DUKE OF.

PICTON, NORMAN. Ueber Umlagerungen aromatischer Nitrokörper. Weida i. Thür. 1908. pp. 51.

PLANCK, MAX. Vorlesungen über die Theorie der Wärmestrahlung. 3rd edition. [Reprint of 2nd edition.] 1919. pp. x + 206.

PLOTNIKOV, V. A. Electrolytic dissociation in solvents with low dielectric constants. Kieff. [n.d.] pp. 18. [In Russian.]

POLLAK, LEOPOLD. Gasanalytische Beiträge zur Kenntnis des Acetylens und Stickoxyduls. Prag 1902. pp. 53. ill.

POPE, THOMAS HENRY. *See* MOLINARI, ETTORE.

PRAGER, BERNHARD. *See* BEILSTEIN'S HANDBUCH DER ORGANISCHEN CHEMIE.

PRATT, R. WINTHROP. *See* KINNICUTT, LEONARD P.

PRIDEAUX, EDMUND BRYDGES RUDHALL. Problems in physical chemistry with practical applications. 2nd edition. London 1920. pp. xii + 294. ill.

PURCELL, PIERCE F. *See* SCIENTIFIC AND INDUSTRIAL RESEARCH, *Fuel Research Board.*

PUSA, AGRICULTURAL RESEARCH INSTITUTE. *Indigo Publication No.* 6. The effect of manuring with superphosphate and sannai . . . especially of rabi crops in the season 1918—19. By WILLIAM ALFRED DAVIS. Calcutta 1920. pp. 30.

RACE, JOSEPH. Chlorination of water. New York 1918. pp. viii + 158. ill.

RASTALL, R. H., and WILCOCKSON, W. H. Tungsten ores. (Imperial Institute Monograph on Mineral Resources.) London 1920. pp. x + 82.

READ, JOHN. *See* AUSTRALIA, COMMONWEALTH OF. *Institute of Science and Industry.*

Reichel, Heinrich, and Gegenbauer, Viktor. Infectivity and disinfection of anthrax in skins and hides. (From the *J. State Medicine*, 1913.)

Rideal, Eric Keightley. Ozone. London 1920. pp. x + 198. ill.

Ries, Chr. Das Selen. München 1918. pp. 379. ill.

Rinkes, Inne Jan. Quantitatief onderzoek over de monohalogeeneering van phenol. Amsterdam 1910. pp. 101.

Rivière, C. *See* Clément, Louis.

Robert, W. Étude sur les travaux de Samuel Baup. (From the *Bull. Soc. Vaud. Sc. Nat.*, 1893, **29**.) ill.

Roberts, Sir William. *See* Leech, Daniel John.

Robertson, John Braithwaite. The chemistry of coal. London 1919. pp. viii + 96.

Röhmann, Franz. Die Chemie der Cerealien in Beziehung zur Physiologie und Pathologie. (Sammlung, Vol. XXII.) Stuttgart 1916.

Roozeboom, H. W. Bakhuis. Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre. Vol. II, ii and iii. Braunschweig 1918. pp. x + 226, viii + 199. ill.

Roscoe, The Right Hon. Sir Henry Enfield, and Schorlemmer, Carl. A treatise on chemistry. Vol. I. The non-metallic elements. 5th edition, revised by John Cannell Cain. London 1920. pp. xvi + 968. ill. (*Reference.*)

Rosenhain, Walter. Glass manufacture. 2nd edition. London 1919. pp. xvi + 258. ill.

Rougier, Louis. La matérialisation de l'énergie. Essai sur la théorie de la relativité et sur la théorie des quanta. Paris 1919. pp. xii + 148.

Royal Photographic Society of Great Britain. A memorial volume containing an account of the photographic researches of Ferdinand Hurter and Vero C. Driffield: being a reprint of their published papers, together with a history of their early work and a bibliography of later work on the same subject. Edited by William Bates Ferguson. London [1920]. pp. xii + 374. ill.

Różycki, Antoni. Über einige Chalkonderivate und Synthese des 2-Brom-3-Aethoxy-3′-Nitroflavons. Bern 1900. pp. 43.

Ruff, Otto. Die Chemie des Fluors. Berlin 1920. pp. viii + 136. ill.

Russell, Edward John. *See* Hall, Sir Alfred Daniel.

Russell, William F. I. Beiträge zur Stereochemie der China-alkaloide. II. Zur Kenntnis der Amidoxime. Weida i. Thür. 1910. pp. 47.

Russian Physical and Chemical Society. Journal. Vols.

XLIII—XLVIII, No. 3. St. Petersburg 1911—1916. [*Chemical Section only.*] (*For circulation.*)

SALLES, PIERRE. *See* CAIN, JOHN CANNELL.

SALTER, C. T. C. *See* SCHWARTZ, — VON.

SAMTER, VICTOR Physikalische Chemie und Patentrecht. Edited with preface by H. GROSSMANN. (Sammlung, Vol. XXI.) Stuttgart 1915.

SASAKI, TAKAOKI. Über die biochemische Umwandlung der primären Eiweissabbauprodukte durch Bakterien. Mitt. II. (From the *Act. Schol. Med. Univ. Imp., Kioto,* 1916, **1**.)

SASAKI, YOMOSHI. Vergleichende Untersuchungen über das Verhalten der oxyhydroaromatischen Körper gegen den Tierorganismus. (From the *Act. Schol. Med. Univ. Imp., Kioto,* 1917, **1**.)

SAVAGE, WILLIAM G. Food poisoning and food infections. Cambridge 1920. pp. ix + 247.

SCANSETTI, V. L'industria dei saponi. 2nd edition. Milano 1918. pp. xxiv + 550. ill.

SCHEIDEGGER, PAUL. Synthesen von Dioxy-Naphtochalkonen Bern 1911. pp. 36.

SCHENCK, RUDOLPH. The physical chemistry of the metals. Translated and annotated by REGINALD SCOTT DEAN. New York 1919. pp. viii + 239. ill.

SCHERRER, ADOLF. Beiträge zur Perkin'schen Reaktion und Synthese von 3-Aethoxyphenanthrenchinon. Zürich 1902. pp. 49.

SCHMIDT, HANS. Die aromatischen Arsenverbindungen. Berlin 1912. pp. iv + 92.

SCHORLEMMER, CARL. *See* ROSCOE, THE RIGHT HON. SIR HENRY ENFIELD.

SCHROEDER, PAUL VON. Ueber japanische Gerbmaterialien. (From the *Deut. Gerber-Zeit.*, 1901, **44**.)

SCHUCHARDT, G Die technische Gewinnung von Stickstoff, Ammoniak und schwefelsaurem Ammonium nebst einer Uebersicht der deutschen Patente. (Sammlung, Vol. XXV.) Stuttgart 1919.

SCHUTT, ERNST. Über die Abscheidung von Aminosäuren mit Hilfe der Karbaminoreaktion. Weida i. Thür. 1912. pp. 69.

SCHWALBE, CARL GUSTAV, and SIEBER, RUDOLF. Die chemische Betriebskontrolle in der Zellstoff- und Papierindustrie und anderen Zellstoff verarbeitenden Industrien. Berlin 1919. pp. xii + 252. ill

SCHWARTZ, — VON. Fire and explosion risks . . . detection, investigation and prevention of dangers arising from fires and explosions of chemico-technical substances and establishments. Translated from the revised German edition by C. T. C. SALTER. London [1904, reprinted 1918]. pp. xxii + 358.

SCHWENK, ERWIN. Grundlagen und derzeitiger Stand der Chemotherapie. (From the *Jahresber. Immunit.*, 1912.)

—— *See* WEICHARDT, W.

SCIENTIFIC AND INDUSTRIAL RESEARCH, Department of. Bulletin No. 1. Memorandum on the preservation of timber in coal mines. By PERCY GROOM.

—— Bulletin No. 2. Memorandum on cutting lubricants and cooling liquids, and on skin diseases produced by lubricants. London 1918. pp. 8.

—— *Advisory Council.* Bulletin No. 4. Memorandum on solid lubricants. London 1920. pp. 28.

—— —— Report of the Lubricants and Lubrication Inquiry Committee. London 1920. pp. 126. ill.

—— *Food Investigation Board.* Special Report No. 1. On the design of railway wagons for the carriage of perishable foods. London 1919 pp. 8.

—— —— Special Report No. 2. The literature of refrigeration. London 1919. pp. 8.

—— —— Special Report No. 4. Interim report on methods of freezing fish, with special reference to the handling of large quantities in gluts. London 1920. pp. ii + 50. ill.

—— *Fuel Research Board.* Report for the years 1918, 1919, etc. London 1920 +. ill.

—— —— Fuel for motor transport · an interim memorandum. London 1920. pp. 10

—— —— Special Report No. 2. The peat resources of Ireland. A lecture given before the Royal Dublin Society, 5th March, 1919, by PIERCE F. PURCELL. London 1920. pp. 25. ill.

—— —— Special Report No. 3. The coal fire. A research by MARGARET WHITE FISHENDEN for the Manchester Corporation Air Pollution Advisory Board. London 1920. pp. 112. ill.

SEARLE, ALFRED BROADHEAD. Bricks and artificial stones of non-plastic materials, their manufacture and uses. London 1915. pp. viii + 150. ill.

SEIDELL, ATHERTON. Solubilities of inorganic and organic substances. 2nd edition. London 1920. pp. xxii + 846. (*Reference.*)

SEN, NAGENDRA NATH. Interaction of phosphorus halides and arsenious and arsenic compounds. (From the *J. Proc. Asiatic Soc. Bengal*, 1919, N.S. **15**.)

SIEBER, RUDOLF. *See* SCHWALBE, CARL GUSTAV.

SIMMONDS, CHARLES. Alcohol: its production, properties, chemistry, and industrial applications. With chapters on methyl alcohol, fusel oil, and spirituous beverages. London 1919. pp. xx + 574. ill.

SIMONIS, HUGO. Die Cumarine. (Chemie in Einzeldarstellungen, Vol. VIII.) Stuttgart 1916. pp. xii + 298. ill.

—— Die Chromone. (Sammlung, Vol. XXIV.) Stuttgart 1917.

SINDALL, ROBERT WALTER. Paper technology: an elementary manual on the manufacture, physical qualities and chemical constituents of paper and of paper-making fibres. 3rd edition. London 1920. pp. xvi + 338. ill.

SINNATT, FRANK STURDY. Notes on coal analysis. (*Lancs. & Cheshire Coal Research Assoc.*, Bulletin No. 4.) 1920.

SINNATT, FRANK STURDY, STERN, HARRY, and BAYLEY, FRANK. Coal dust and fusain. (*Lancs. & Cheshire Coal Research Assoc.*, Bulletin No. 5.) 1920. pp. 20.

SLOANE, THOMAS O'CONOR. Liquid air and the liquefaction of gases. 3rd edition. London 1920. pp. 394. ill.

SMEDLEY, IDA. Die biochemische Synthese der Fettsäuren aus Kohlenhydraten. (From the *Centr. Physiol.*, 1912, **26**.)

SMITH, H. G. *See* AUSTRALIA, COMMONWEALTH OF. *Institute of Science and Industry.*

SOCIETĂŢEI DE CHIMIE DIN ROMÂNIA. Buletinul. Year I, etc. Bucureşti 1919+. (*Reference.*)

SOCIETY OF CHEMICAL INDUSTRY. Reports of the progress of applied chemistry. Vol. II, 1917, etc. London 1918+. (*Reference.*)

SOCIETY OF GLASS TECHNOLOGY. Journal. Vol. I., etc. Sheffield 1917+. (*For circulation.*)

SOMMERFELD, ARNOLD. Atombau und Spektrallinien. Braunschweig 1919. pp. x + 550. ill.

SORBY, H. C. On the colour of leaves. (From the *Quart. J. Micros. Sci.*, 1871, **11**.)

SPENCE, DAVID. Ueber die Isomerieerscheinung bei den sogenannten Hagemannschen Estern. Jena 1905. pp. 40.

SPRINGER, LUDWIG. Laboratoriumsbuch für die Glasindustrie. Halle (Saale) 1919. pp. x + 142.

SRINIVASAN, KALYAN C. The manufacture of glue in the tropics from tannery refuse. Madras 1919. pp. ii + 24. ill.

STÄHLER, ARTHUR. [Editor.] Handbuch der Arbeitsmethoden in der anorganischen Chemie. Vol. II, i. Berlin 1919. pp. x + 654. ill. (*Reference.*)

STANFORD, ROBERT VINER. A new method for the estimation of minute quantities of nitrogen in organic substances, which furnishes a new quantitative method of diagnosis in some cases of mental disease. (*Rep. Chem. Lab. Cardiff City Mental Hospt.*, 1919, No. 2.)

STAS, JEAN SERVAIS. Manifestation en l'honneur de Jean-Servais Stas. Bruxelles 1891. pp. iv + 92.

—— *See* ERRERA, L.

STEIN, MILTON F. Water purification plants and their operation. 2nd edition. New York 1919. pp. x + 270. ill.

STERN, HARRY. *See* SINNATT, FRANK STURDY.

STEWART, ALFRED WALTER. Stereochemistry. 2nd edition. London 1919. pp. xvi + 277. ill.

STIASNY, EDMUND. Die Wirkungsweise der Kalkäscher. (From *Der Gerber*, 1906.)

—— Uber die bisherigen Gerbstoffbestimmungs-Methoden ohne Verwendung von Hautpulver. (From *Der Gerber*, 1907.)

—— Ueber eine Gerbstoff-Reaktion und ihre Anwendungen. (From *Der Gerber*, 1908.)

STILLMAN, THOMAS BLISS. Engineering chemistry. A manual of quantitative chemical analysis for the use of students, chemists and engineers. 5th edition. Easton, Pa., 1916. pp. viii + 760. ill.

STOCKS, HERBERT BIRTWHISTLE. *See* FRITSCH, J.

—— *See* HUBBARD, ERNST.

—— *See* KRAUCH, C.

STOLL, ARTHUR. *See* WILLSTÄTTER, RICHARD.

SUDBOROUGH, JOHN JOSEPH. Diortho substituted benzoic acids. London 1895. pp. 32.

SVEDBERG, THE. Die Methoden zur Herstellung kolloider Lösungen anorganische Stoffe. 2nd edition. [Reprint of 1st edition.] Dresden 1920. pp. x + 507.

TAYLOR, HUGH STOTT. Fuel production and utilization. London 1920. pp. xiv + 298. ill.

THOMAS, M. BEATRICE. *See* FREUND, IDA.

THOMPSON, KENWORTHY JAMES. I. Über die Isomerie der sogenannten Benzolazocyanessigester. II. Zur Kenntnis der Diazoverbindungen. Weida i. Thür. 1906. pp. 50.

THOMPSON, SILVANUS PHILIPPS. Lord Kelvin. London 1912. pp. 38. ill.

TINKLER, CHARLES KENNETH, and MASTERS, HELEN. Applied chemistry: a practical handbook for students of household science and public health. Vol. I. Water, detergents, textiles, fuels, etc. London 1920. pp. xii + 292. ill.

TROTMAN, SAMUEL RUSSELL. Leather trades chemistry. A practical manual on the analysis of materials and finished products. London 1908. pp. x + 290. ill.

TRUNKEL, HANS. Über Leim und Tannin. Eine Betrag zur Kenntnis der Kolloide. Weida i. Thür. 1910. pp. 96. ill.

TSCHEBOTAREFF, SOPHIE. Versuche zur Synthese des Chromenols. Bern 1911. pp. 28.

TSUDJI, MIDORI. Über die asymmetrische Spaltung des racemischen Tyrosins durch *Bacillus proteus vulgaris* und *Bacillus subtilis*. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1917, **1**.)

—— Über den bakteriellen Abbau von *d*-Tyrosin, mit besonderer Berücksichtigung des stereochemischen Verhaltens der Abbauprodukte. (From the *Act. Schol. Med. Univ. Imp., Kioto*, 1918, **2**.)

TSVETT, MICHAIL. Les chromophylles dans les mondes végétal et animal. 1910. pp. vi + 380. ill. [In Russian.]

UNITED STATES. *Division of Chemistry.* Bulletin. Nos. 8, 9, 13 pts iii, iv, v, 17, 19, 22, 23. Washington 1886—1889. (*Reference.*)

VALLERY-RADOT, RENÉ. The life of Pasteur. Translated by MRS. R. L. DEVONSHIRE. With an introduction by SIR WILLIAM OSLER. London 1919. pp. xxii + 484. ill.

VANZETTI, BARTOLO LINO. *See* PELLINI, GIOVANNI.

VENTUROLI, GIUSEPPE. Concia delle pelli. 4th edition. Milano 1913. pp. xiv + 206. ill.

VOGEL, J. H., and others. Das Acetylen: seine Eigenschaften, seine Herstellung und Verwendung. (Chem. Tech. in Einzeldarstellungen.) Leipzig 1911. pp. viii + 294. ill.

WALKER, JAMES. Introduction to physical chemistry. 8th edition. London 1919. pp. xx + 332. ill.

WALLIS-TAYLER, A. J. Refrigeration, cold storage, and icemaking . . . with which is incorporated "Refrigerating and icemaking machinery" (4th edition). 6th edition. London 1920. pp. xxiv + 652. ill.

WARREN, CYRUS MOORS. [Obituary notice.] (From the *Proc. Amer. Acad.*, 1891, **27**.) ill.

WASHINGTON, HENRY STEPHENS. Manual of the chemical analysis of rocks. 3rd edition. New York 1919. pp. xii + 271. ill.

WATT, JAMES. *See* KELVIN, LORD.

WEICHARDT, W., and SCHWENK, ERWIN. Weitere Versuche über die Entgiftung von Eiweissspaltprodukten von Kenotoxincharakter. (From the *Zeitsch. Immunit.*, 1913, **19**.) ill.

WEIMARN, PETR PETROVIČ VON. The contractibility of the vectorial energy of the volume and surface and the latent heat of moss. (From the *Proc. Min. Inst. Empress Catherine II*, 1913, **4**.) [In Russian.]

—— Énergies contractives et expansives de volume et de surface,

propriétés physico-chimiques et état thermique des substances. Pétrograd 1915. pp. 58. [In Russian.]

WEST, CLARENCE JAY. Chemical warfare. [Bibliography.] (From *Special Libraries*, 1919.)

—— A short bibliography of sulfite alcohol: a list of articles on the production of alcohol from sulfite waste liquor. (From *Paper*, 1919, **25**.)

—— The electric furnace as applied to metallurgy: a reading list, 1900—1919. (From *Trans. Amer. Electrochem. Soc.*, 1920, **37**.)

—— Reading list on molasses. Cambridge, Mass. 1920. pp. 52.

WEST, CLARENCE JAY, and GREENMAN, EDWARD D. A reading list on industrial research. With an introduction by ARTHUR D. LITTLE. (From *Special Libraries*, 1920.)

WEST AFRICA. Committee on edible and oil-producing nuts and seeds. Report and minutes of evidence. 2 vols. London 1916. pp. 48, ii + 234.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE. Journal. Vol. 27, etc. Glasgow 1919 + . (*Reference.*)

WESTCOTT, W. WYNN. *See* MARTINDALE, WILLIAM HARRISON.

WESTON, FRANK EDWIN. *See* FRYER, PERCIVAL JOHN.

WHELDALE, MURIEL. *See* ONSLOW, MURIEL WHELDALE.

WHINYATES, LEONARD. *See* ATACK, FREDERICK WILLIAM.

WHITBY, GEORGE STAFFORD. Plantation rubber and the testing of rubber. London 1920. pp. xvi + 560. ill.

WHITE, WALTER P., and ADAMS, LEASON H. A furnace temperature regulator. (From the *Physical Rev.*, 1919, N.S. **14**.)

WIESNER, JULIUS VON. Die Rohstoffe des Pflanzenreiches. 3rd edition. Vol. II. Leipzig 1918. pp. x + 876. ill.

WILCOCKSON, W. H. *See* RASTALL, R. H.

WILL, CARL WILHELM. Zum Gedächtniss an A. W. v. Hofmann. Berlin 1892. pp. 17.

WILLSTÄTTER, RICHARD, and STOLL, ARTHUR. Untersuchungen über die Assimilation der Kohlensäure. Berlin 1918. pp. viii + 448. ill.

WINKLER, CLEMENS. Lehrbuch der technischen Gasanalyse. 4th edition, edited by OTTO BRUNCK. Leipzig 1919. pp. xii + 254. ill.

WINSLOW, C.-E. A. *See* KINNICUTT, LEONARD P.

WINTON, ANDREW LINCOLN. *See* LEACH, ALBERT ERNEST.

WOKER, GERTRUD. Theoretisches über die Mischnarkose. (From the *Z. allg. Physiol.*, 1913, **15**.)

Woker, Gertrud. Die Katalyse. (Die chemische Analyse, Vol. XXI./XXII.) Stuttgart 1915. pp. xxii+790. ill. (*Reference.*)

Wollenweber, Wilhelm. Beitrag zur Kenntnis der Filixgerbsäure. Berlin 1906. pp. 48.

Wood, Joseph Turney. Das Entkälken und Beizen der Felle und Häute. From the English edition revised, with the help of the author, by Josef Jettmar. Braunschweig 1914. pp. xiv+228. ill.

Woodcock, William H. *See* Blount, Bertram.

Wootton, William Ord. *See* Cahen, Edward.

Wunderlich, Adolf. Über die Rhamnoglucoside aus *Viola tricolor*, *Polygonum fagopyrum*, *Capparis spinosa*, *Aesculus hippocastanum*, und *Globularia alypum*. Marburg 1908. pp. 83.

Young, W. J. *See* Breinl, A.

Zeitschrift für Elektrochemie und angewandte physikalische Chemie. Vol. 26, etc. Halle a. S. 1920+. (*For circulation.*)

Zeitschrift für Metallkunde. Organ der Deutschen Gesellschaft für Metallkunde. Zentralblatt für die gesamte Theorie und Praxis der Metalle und Legierungen. Vol. XII, etc. Berlin 1920+. (*Reference.*)

Ziegler, Hugo. Zur Kenntnis des Anthracens und des α-Methylanthracens. Borna-Leipzig 1912. pp. 35.

Zsigmondy, Richard. Kolloidchemie. 2nd edition. Leipzig 1918. pp. xvi+402. ill.

Zwayer, Felicia. Ueber die Funktion des Doppelchromophors CO·C=C. Bern 1909. pp. 27.